Grain Market Outlook

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Foreword

This study was undertaken as part of the Economic Council's project on the Future of the Prairie Grain Economy – a project referred to the Council by the Prime Minister in a letter dated March 31, 1987.

> I am encouraged to see the Council proposing a significant collaborative effort with federal and provincial governments and the private sector. I am pleased to support this particular study as a vehicle for public debate on a pressing problem which concerns us all, the future of the Prairie grain economy. I expect it to produce an invaluable exchange of information, while leaving the Council, as always, to its own independent views, conclusions, and recommendations.

This particular study examines the international market for wheat and coarse grains through to 1995 on the basis of analyses of supply and demand in 13 countries and regions. It reviews the determinants of world grain prices emphasizing the role of United States' farm support policies. The study also examines the international market for canola – a high quality rapeseed developed in Canada.

The Council received financial support for this project from the governments of Saskatchewan and Alberta, the federal Department of Agriculture, The Prairie Pools Incorporated, Cargill Limited, and the Royal Bank of Canada. Representatives of these organizations, as well as independent experts, gave generously of their time to attend meetings of the project's Technical Advisory Committee. The Council is glad to acknowledge this valuable support.

Other studies in this series will deal with the international policy environment shaping the grain trade, the effects of eliminating agricultural trade-distortions, Canadian policy towards Prairie agriculture, the effects of the cost-price squeeze on Prairie farms and the opportunities for diversifying agriculture in the Prairie provinces. The Council put forward its recommendations for improving public policy regarding Prairie agriculture in a Statement published in November 1988.

Dr. Andrew Schmitz of the University of California, Davis, and the University of Saskatchewan was director of research for this study. Dr. Hartley Furtan, Dr. Richard Gray, and Dr. Gary Storey are members of the Department of Agricultural Economics, and T. Y. Bayri is research associate in the same department at the University of Saskatchewan.

Judith Maxwell
Chairman

1 Forecasting the Grain Situation of the Future

The grain economy of the world has always been turbulent. Prices of grains have fluctuated because of wars, weather, and the discovery and development of new lands. The fluctuating grain prices have spelt disaster for some and prosperity for others.

In Canada, the fluctuating grain prices have had an important impact on the Prairie economy. Farmers experienced bad times in the 1930s and good times in the 1970s, with the financial situation of individual farmers depending largely upon their debt load. Since the early 1970s, the government has introduced a number of policies to support farmers' low incomes from depressed grain prices (e.g., the *Western Grain Stabilization Act*). These programs were thought to provide the support that farmers would need to get them through periods of low grain prices. Now, however, in 1988, the future of the Prairie grain economy is again in question as a result of the chronic oversupply of cereal growers in the world. The Canadian public is questioning the long-term economic viability of the Prairie grain economy and the usefulness of providing economic support to that sector of the economy; this was brought about by the drop in worldwide grain prices in the 1985/86 crop year. There is concern that the Prairie grain economy may be non-competitive in the long run. If grain prices are temporarily low, we would expect prices to rise in the future and the grain sector to become profitable; however, should the long-term prospect for grain prices remain low, then major adjustments to the farm structure will be necessary.

The purpose of this report is to forecast demand and supply conditions in the Canadian wheat, coarse-grain, and oilseed markets to 1990 and 1995. The future of the Prairie grain economy is dependent upon the future supply and demand situation in international grain markets. In order to arrive at a reasonable forecast of these conditions, we have developed country assessments of the production, consumption, and trade of wheat, coarse grains, and oilseeds.

Some segments of the world's grain economy are not included in this study. We do not examine food aid because it is relatively limited and has little impact on the commercial grain markets. Nor are major changes in the ability of the less-developed countries (LDCs) to export and import food considered, as there is likely to be little change in those countries before 1995 that would have any impact on the commercial grain situation. Therefore, we place our emphasis on the existing major producers, importers, and exporters in the grain economy of the world.

The first chapter of this report is a general introduction to the problem of low grain prices, and it explains how prices are set in the international market. The second chapter is an overview of the Prairie grain economy. The third, fourth, and fifth chapters provide country assessments for wheat, coarse grains, and oilseeds, respectively. The final chapter draws some general conclusions as to the future of grain prices.

The Role of Governments and Food Policies

Importing and exporting countries often subsidize their agriculture. Some – like Canada, for example – have a myriad of government policies designed to help farmers carry on their business. Similarly, importing countries like Japan have both tariff and non-tariff barriers that restrict imports and protect their domestic producers from foreign competition. The net result of these government policies is that the production, consumption, and prices of grains and oilseeds are out of balance. This, along with government policy to remove grain from the market in order to keep prices higher than they would normally be, has resulted in a large build-up of stocks.

An examination of the wheat-stocks data for the period 1960-86 indicates that a certain relationship exists between wheat stocks and wheat prices. When the volume of wheat stocks held by the U.S. government was large relative to total utilization, the market price for wheat was the U.S. support price for wheat (i.e., the loan rate); however, in periods when stocks were depleted, as in the mid-1970s, the market price for wheat was well above the support price. Clearly, the government policy to hold stocks had an influence on the price that farmers received for their product.

As demonstrated in this chapter, there is a link between the U.S. loan rate for wheat and the price that Canadian farmers receive for it. The loan rate (i.e., the price at which wheat moves into stocks), together with U.S. production and consumption (domestic and for export), determines the level of U.S. wheat stocks. Thus, to forecast trends in the Canadian wheat price, we first examine the wheat-stocks/wheat-price relationship in the U.S. economy. This same relationship holds for other grains such as corn, barley, and durum.

Wheat Prices

Canada produces 4 per cent of the world's total wheat production and conducts 20 per cent of the world's wheat trade.[1] The United States, while not the largest producer of wheat (the Soviet Union and China produce almost as much as it does), is the largest wheat trader. Because of its dominant position, the U.S. domestic wheat policy and its stockholding policy have become the price-setting mechanisms for the wheat export market.

The U.S. producers of wheat have a choice between entering the government grains program or remaining outside the program and receiving the market price for their grain. Depending upon the program particulars, most farmers join the program and are thus eligible for the financial benefits. This type of program is not available to Canadian wheat producers because of policy differences between the two countries.

There are at least three major components of the U.S. wheat program that affect the export price of Canadian wheat. Once the U.S. farmer agrees to join the government program, he must set aside a portion of his base wheat acreage. The wheat produced on the remaining acreage becomes eligible for the target price of wheat. The target price is set by a cost-of-production formula agreed to by the U.S. Congress. The loan price, or loan rate, is the wheat price at which the U.S. government puts the grain into government storage. If the loan rate is higher than the market clearing price, government stocks will increase at the expense of the U.S. taxpayer.

The U.S. target price, loan rate, and farm price for wheat, as shown in Chart 1-1, are the keys to the Canadian wheat export price. The loan rate was increased in the United States until the adoption of the 1985 *Food Security Act* (Farm Bill), at which time the loan rate was lowered. The U.S. government made the decision to lower the loan rate on wheat because of the large build-up of stock in the United States and the corresponding loss of its share of the world's wheat trade.

In the 1985 *Food Security Act*, the United States introduced an additional program to reduce the stocks of grain held by the government. This was the Export Enhancement Policy (EEP), which is a subsidy by the U.S. Treasury on U.S. grain bound for export. For example, if a country purchases wheat from the United States at the prevailing price in the U.S. market, the U.S. Treasury will negotiate a per-unit subsidy. The net effect of this policy is to lower the export price for U.S. grain, as well as the world-market price of grain because of the U.S. share of the market. The European Community (EC) has followed a somewhat similar policy in increasing the export restitution for some grain exports. For Canadians, this translates into a lower export price, in addition to a much lower return to the grain producer.

The export price for barley in Canada is also influenced by U.S. policy, in a fashion similar to that for wheat. In the coarse-grain market, corn dominates the price-setting process. The U.S. corn exports are especially dominant in setting the coarse-grain prices, because the United States is, by far, the largest trader in that market. As shown in Chart 1-2, the loan rate for U.S. corn was also lowered in 1985 because of the large build-up of stock and the desire to reduce those stocks in the United States.

The two major exporters of durum are Canada and the United States. The price of durum wheat in the United States is also set by the target price and loan rate; however, this market is smaller than that of both coarse grains and wheat.

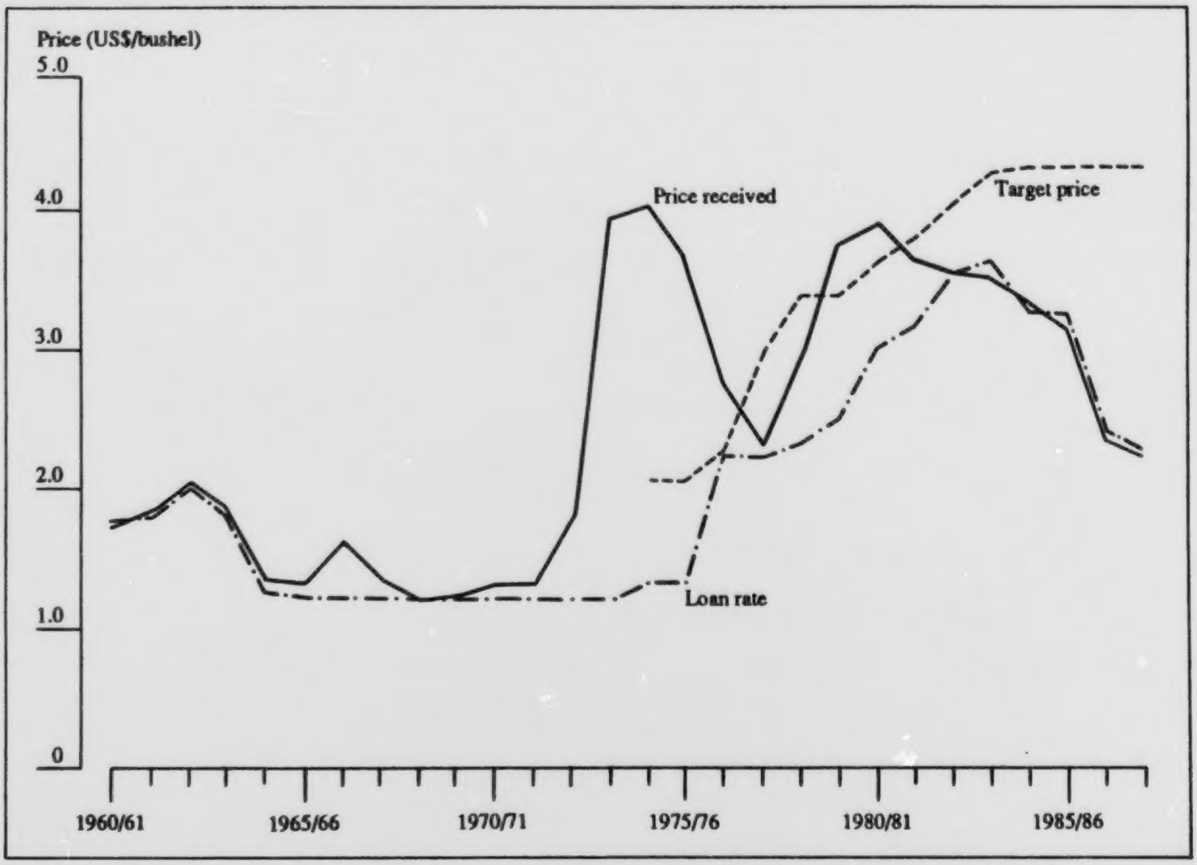
The floor price for both wheat and barley is set by the corn price. Since all cereal grains are used in the feeding of animals, the final demand for wheat and barley depends upon the demand for red meat. Corn is the major coarse grain fed to animals, and once the human-consumption demand (i.e., the bread market) is met, all grains eventually compete in this market.

Canola/rapeseed and flaxseed prices are strongly influenced by prices in the U.S. soybean complex, particularly those of soybean oil. The U.S. government provides nonrecourse loans for soybeans similar to those for wheat and feed grains.

The difference is that the loan rate set for soybeans has seldom – in fact, only twice in the last 15 years, in 1986 and 1987 – served as an effective floor price. This is because the loan rate has been below the soybean market price, as well as below the price received by farmers. Under the 1985 Farm Bill, the loan rate was set at $5.02/bushel for the 1986/87 crop year. For the 1988-90 crops, the loan rate could be 75 per cent of the season's average price received

Chart 1-1

Wheat Prices in the United States, Crop Years 1960/61 to 1987/88



SOURCE U.S. Department of Agriculture, Economic Research Service, *Wheat: Background for 1985 Farm Legislation*, Agriculture Information Bulletin No. 467 (Washington, D.C.: USDA, September 1984).

by farmers over the preceding five years (excluding the high- and low-price years). The loan rate, however, cannot be reduced by more than 5 per cent per year and cannot be below $4.50 because of legislation.

Unlike wheat and feed grains, there is no acreage-reduction program for soybeans. Soybeans are not eligible for either storage payments or the grain-reserve program. Soybean plantings are strongly influenced by the existing programs, however, because in production soybeans substitute for other crops, especially corn.

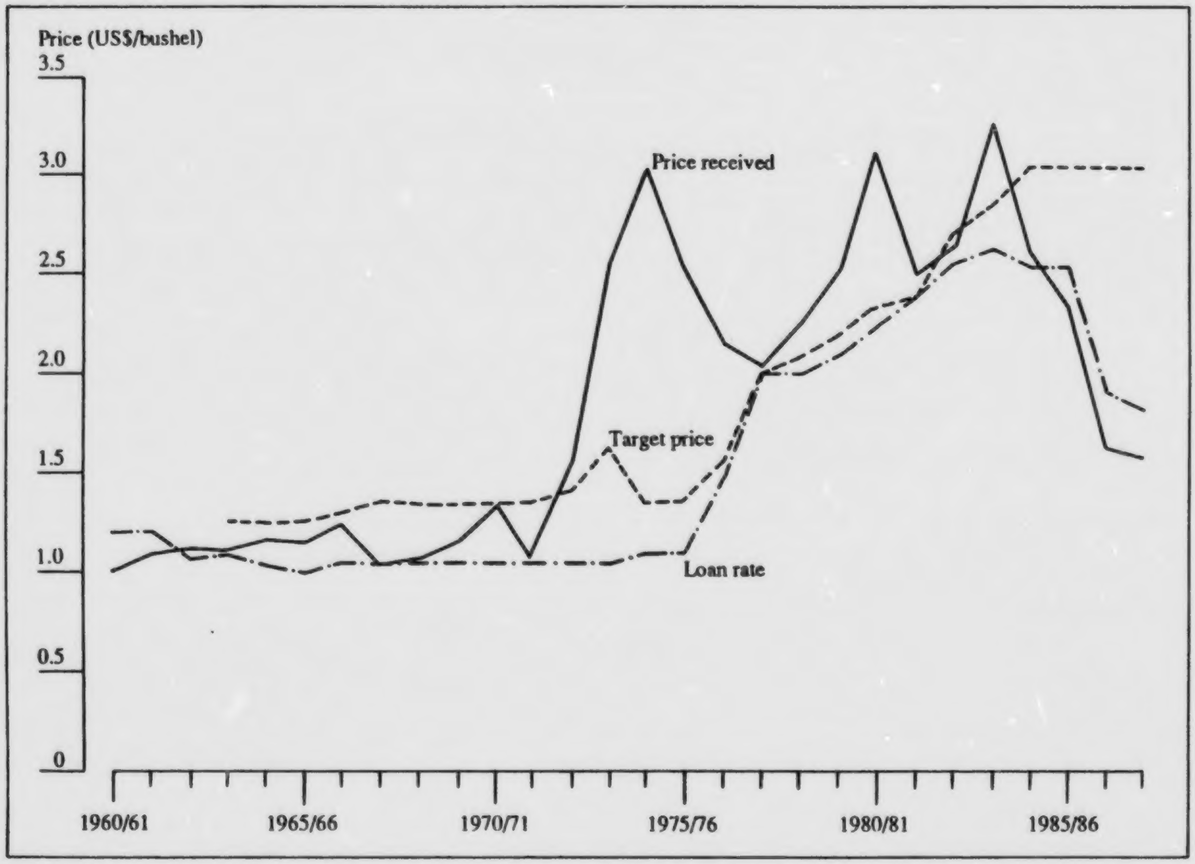
The Price/Stock Relationship

Important knowledge to be gleaned from the relationship between wheat prices and wheat stocks is the point at which prices begin to reflect a shortage of supply. A number of studies have been completed, estimating the wheat-stock/wheat-price relationship.[2] There is no simultaneity between supply and demand; thus the stock/use ratio is used as a measure of scarcity or abundance. In this study, we analyze how the coarse-grain price and the world's coarse-grain stock/use ratio is related to the wheat price and the world's wheat stock/use ratio. As expected, wheat prices start to increase once the wheat stocks as a percentage of wheat use reach 20 per cent, as shown in Chart 1-3. The details of the relevant econometric analysis are presented in Appendix A.

In interpreting any increase in the market price of wheat as a result of a decline in stocks, one important consideration is that Canadian farmers will not realize any change in net revenues from a small change in the world price. In

Chart 1-2

Corn Prices in the United States, Crop Years 1960/61 to 1987/88



SOURCE U.S. Department of Agriculture, Economic Research Service, *Corn: Background for 1985 Farm Legislation*, Agriculture Information Bulletin No. 471 (Washington, D.C.: USDA, September 1984).

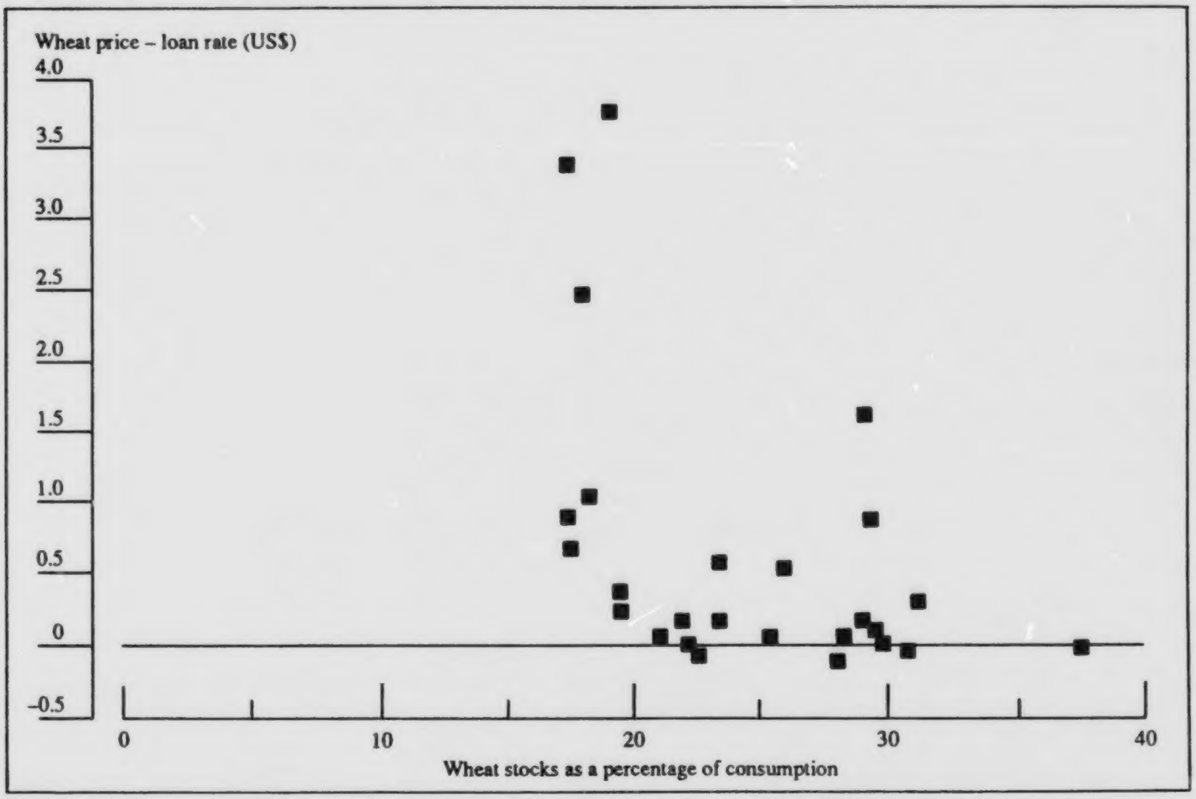
Canada, the federal government is currently subsidizing wheat prices through the Special Canadian Grains Program (SCGP), and farmers continue to receive payments from the *Western Grain Stabilization Act* (WGSA). Any increase in wheat prices will only substitute for those payments. The majority of grain stocks held by governments is held in the United States (40 per cent of total wheat stocks and 75 per cent of coarse-grain stocks). It is therefore essential to understand the U.S. government's policy towards stocks and stock holding. In other words, we must forecast U.S. government policy before we can forecast wheat prices.

In the *Food Security Act* of 1985, the U.S. government clearly stated its policy on wheat stocks. It is moving toward significantly lowering the level of grain stocks held by the government. This policy is being carried out by: 1) lowering the loan rate; 2) increasing the set-aside acreage; and 3) instituting the Export Enhancement Program. Basically, the U.S. policy is to lower the production of wheat around the world by lowering the loan rate, decreasing domestic production by increasing the set-aside acreage, and reducing U.S. stocks by capturing a larger percentage of the export market through direct export subsidies.

This policy obviously has a devastating effect upon Canadian grain producers. Not only has the loan rate reduced the Canadian export price, the price is further reduced by the U.S. export subsidies on wheat and coarse grains. The net effect is that Canadian farmers must compete in the export market against a twice-subsidized wheat price. This translates into the historically low returns to Canadian wheat farmers.

Chart 1-3

The U.S. Wheat Price and World Wheat Stock/Use Ratio, Crop Years 1960/61 to 1986/87



SOURCE U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, various issues.

In order to forecast the future market outlook, we need to estimate annual wheat and coarse-grain stocks, and this requires us to estimate the production and consumption of wheat and coarse grains. In this study, we estimate the production of grains – both wheat and coarse grains – in the major producing countries. Then by estimating consumption in the producing countries and major importing countries, we can predict trade and stock levels. This analysis does not include short-term weather shocks; rather, it looks at the long-term trends to 1995.

The relationship between oilseed prices and oilseed stocks is different than that for cereal grains. The price of canola and flax is determined by the demand and supply conditions for canola oil and meal, soybean oil and meal, and linseed oil. In forecasting the future market conditions for oilseeds in Canada, the U.S. soybean industry is the market setter. This can be seen in Chart 5-1, which shows the high correlation between canola prices and soybean prices.

Methodology Used to Forecast the Production and Consumption of Grains

Production

Estimates of the future production of wheat and coarse grains were taken from an earlier study by Furtan *et al.*[3] The production of wheat in the United States, Canada, and the European Community was projected using a linear programming model; detailed information on the projections is available in Appendix B. This model allowed for analyzing the effects of government subsidies and acreage set-aside programs (and their removal) on production.

The production of wheat and coarse grains for countries such as China, the Soviet Union, and India were estimated by using past trends. While this method is unsatisfactory in many respects, it is the best method available to the researchers. Countries like China cause real problems when using trends, because much of the past increase in production was due to policy changes. Those changes are not likely to be repeated, so the trends will definitely change in the future. For that reason, we modify the trends of each country based on other available information. This is discussed in more detail in the country assessments that appear throughout this report.

Consumption

The future consumption of wheat and coarse grains in each country, or group of countries, was estimated using past data on the annual utilization of grain. The econometric model that was employed follows the analysis of the Food and Agriculture Organization (FAO), which specified annual consumption as a function of population and income. Further information on forecasting consumption is available in Appendix C.

Forecast-Sensitivity Analysis

A sensitivity analysis was performed on the consumption and the production forecasts. On the consumption side of the equation, a high- and a low-growth rate of per-capita income was used to forecast the most likely high and low consumption. The projections of per-capita income are presented in Appendix C.

The sensitivity of production was determined by modifying the production trends for each country. The low-production scenario depicts a situation where yields remain low because of either low prices or unfavourable production conditions; the high-production scenario assumes the opposite. These scenarios allow for a sensitivity of stocks, trade, and prices. A more detailed discussion of this is included in the country assessments.

2 The Grain Economy of the Prairies

The grain economy of the Prairies in 1988 is in the worst financial situation since the Great Depression! Farmers who, a few years ago, expected to make a good living from producing cereal grains now find the returns from that market insufficient to cover the cost of production. In the 1970s, many young farmers entered what appeared to be a buoyant industry. Many of them purchased land and took on a financial commitment that they fully expected to be able to meet. Today, many of those same individuals are finding they cannot meet their payments and are faced with the prospect of having to leave agriculture.

All is not doom and gloom in the grains sector of agriculture, however; some farmers are still able to make a profit in spite of the current low level of returns. They are primarily the farmers with no current agricultural debts. The market for grains is turning around, but it is not clear when it will completely recover.

As shown in this chapter, the primary problem in agriculture is the price of the commodities. Farmers have successfully adopted new technologies and have achieved good yields, only to have the bottom fall out of their prices.

Grain Prices

The price of grain received by the Prairie farmer is a composite of the domestic market price and the export price. Spring wheat and durum are primarily for export, while one-half of the barley produced is for export and one-half is for the domestic market. The domestic market for spring wheat is predominantly for human consumption, although some of it is used for animal feed; the domestic durum market, however, is totally for human consumption.

The price variability in the domestic market is different from that in the export market. Canada follows an active two-price wheat policy in the domestic market. The price of wheat sold by the Canadian Wheat Board to domestic millers is currently fixed at $7.00/bushel. Canadians consume approximately 1.9 million tonnes (metric) of wheat per year, of which 80 per cent is grown in the Canadian Wheat Board zone. The domestic feed price for barley and wheat is set on the Winnipeg Commodity Exchange; however, given the role of the Canadian Wheat Board in exporting grains, that feed market does not always function as efficiently as it should.[1]

Canola/rapeseed is utilized to produce edible vegetable oil and protein meal; flaxseed, to produce industrial oil and protein meal. Approximately 55 per cent of canola/rapeseed production is exported, compared with 80 per cent of flaxseed. The prices of both canola/rapeseed and flaxseed are determined through the cash and futures markets of the Winnipeg Commodity Exchange.

As the majority of grains produced on the Prairies is exported, the price received by farmers is determined in the export market. The final price received for spring wheat, before direct government transfers, as shown in Chart 2-1, is at a record-low level. The only time that prices ever reached a similar low was in the 1930s.

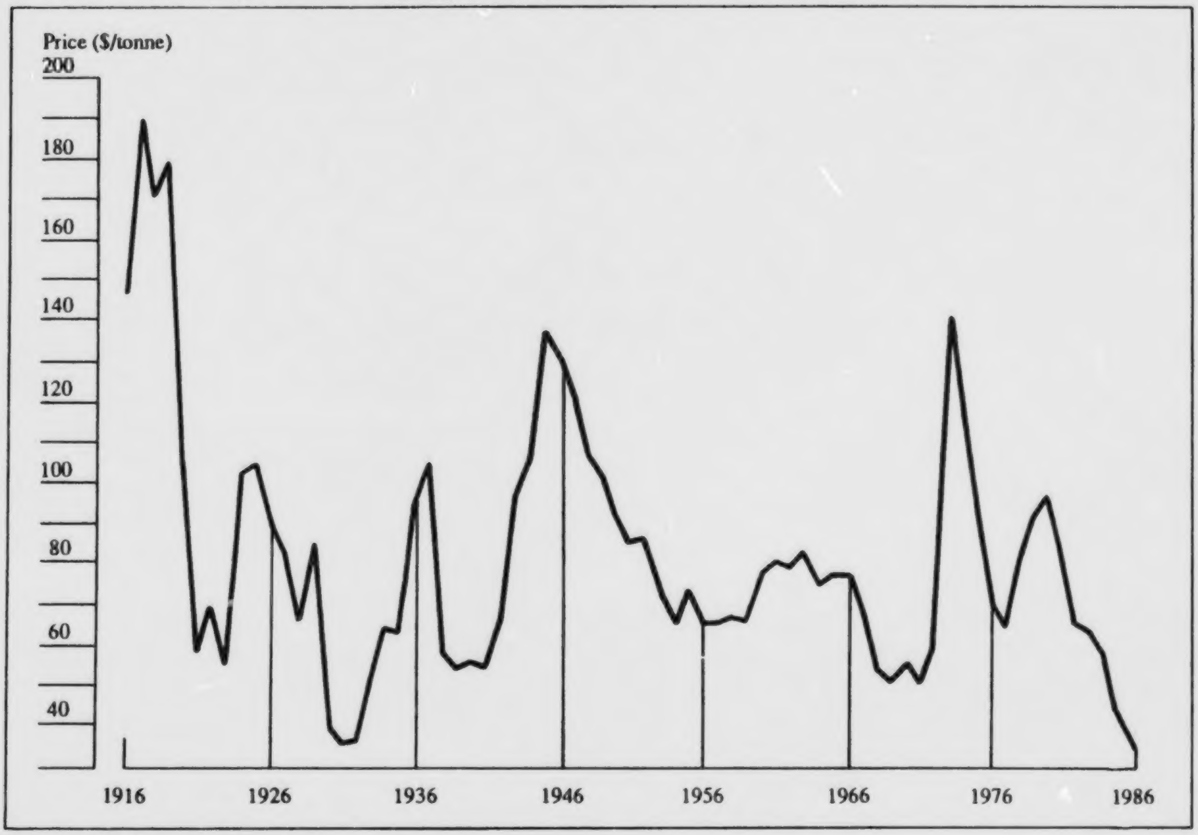
The data in Chart 2-1 cover a 70-year period from 1916 to 1986. They show that the price of wheat does not follow a cyclical pattern; instead, it is subject to sharp fluctuations. The prices received by farmers for durum wheat and barley follow a pattern similar to that for spring wheat.

Another way to analyze the farm financial crisis is to examine the returns per acre. Although prices may be declining, the returns per acre could be rising because of yield changes or management. The returns per acre for wheat production, shown in Chart 2-2, present much the same picture as do changes in the wheat price. The returns – including support payments under the *Western Grain Stabilization Act* and the Special Canadian Grains Program – were lower for the 1986 crop than at any time since 1960.

Farmers in the Prairie region have reacted to the violent swings in price and returns per acre by maintaining acreage and production. They have increased the acreage of spring wheat, mainly because of a decline in summer-fallow acreage. While the acreages of durum and barley do change somewhat from year to year, they change much less than do their respective prices. The reason for the relatively constant acreage is that the prices of different grains tend to move together. Thus while profitability may drop, there is no incentive to switch crops.

Chart 2-1

The Price[1] Received by Farmers for Spring Wheat, Saskatchewan, 1916-86



1 Deflated by the consumer price index.

SOURCE Compiled from Saskatchewan Agriculture, *Agricultural Statistics, 1985*; Statistics Canada, *Historical Statistics of Canada*, second edition, Series K8-18, 1983; and Statistics Canada, *Consumer Price Index, 1986*, Cat. 62-001.

Following the Second World War, canola/rapeseed acreage increased steadily, reaching 7.5 million acres by 1976. Grown primarily in the parkland region, it substitutes for spring wheat and barley, depending on the relative stocks and price changes. Flaxseed is a traditional crop, with acreage remaining relatively steady at between 1 and 3 million acres.

Technological Changes in the Grain Economy

The major source of growth in grain production on the Prairies has been the increase in crop yields. Since 1960, yields of wheat, barley, and durum have increased with the release of new varieties.

Effect of Change in Grain Yields

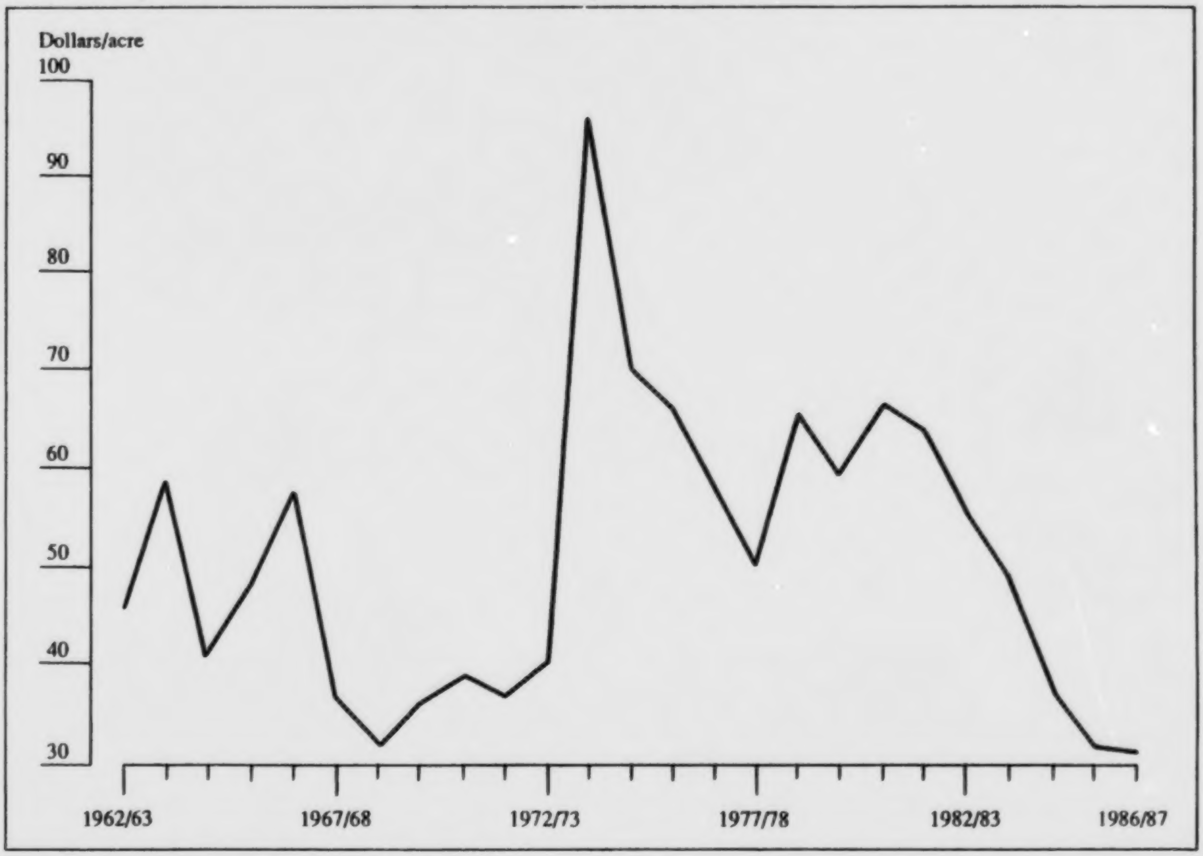
There are at least two ways in which to measure the effect of changing crop yields. We can compare 1) the potential yields (i.e., the yields achieved at research stations); and 2) the actual farm yields achieved by producers. The farm yields reflect the impact of management, fertilization, crop rotation, and government policy.

The potential yields recorded by scientists on the research plots represent the maximums that can be achieved.[2] The growth rates in crop yields presented in Table 2-1 show how the maximum has been changing, both in Canada and the United States.

The data in Table 2-1 pertain to a small area of the southern Prairies in Canada and the northern plains of the

Chart 2-2

Net Returns per Acre[1] for Wheat, Prairie Provinces, Crop Years 1962/63 to 1986/87



1 Deflated by the consumer price index.

SOURCE Saskatchewan Agriculture, *Agricultural Statistics, 1985*; Statistics Canada, *Consumer Price Index, 1986*, Cat. 62-001; and Canadian Wheat Board, *Annual Reports, 1973/74* and *1985/86*.

United States. In those two regions, soil, climate, and the quality of grain are the same across international boundaries. The differences arise from government policy towards research and marketing, and they appear not to have slowed the growth in crop yields in Canada compared with those in the United States.

In the international wheat market, however, Canada must compete with regions other than the northern U.S. plains. Countries such as England, France, Australia, and the United States (aggregate) are the main competition. Since those countries do not have climates or grade standards similar to Canada's, we cannot compare research-station yields.

The actual farm yields of wheat and barley in France, the United Kingdom, the United States, Australia, and Canada are shown in Charts 2-3 and 2-4. Canadian yields have lagged far behind those of Europe and the U.S. aggregate. It should be noted that the yield advantage in Europe does not imply that Europeans have a comparative advantage in cereal grains, because much of their gains stem from the substantial subsidies received by farmers; European farmers have also made significant changes in their grain technology that have resulted in a substantial increase in production.

The use of herbicides and pesticides has increased the yields in all countries. In the grain economy of the Prairies, the control of wild oats has increased production by 4 to 5 per cent per year, whereas in Europe, the use of growth regulators and Intensive Crop Management (ICM) has increased yields by 20 per cent. These technological

Table 2-1

Average Annual Growth Rate of Crop Yields on Research Plots, Selected Regions, Canada and the United States, 1965-85

	Growth rate	
	Canada	United States
	(Per cent)	
Type of crop:		
Hard red spring wheat	0.58	0.64
Semi-dwarf wheat	0.27	0.02
Amber durum[1]	0.93	0.00
Spring barley[1]	1.46	0.65

[1] Figures denote the statistical difference between the two countries.

SOURCE P. Molder, "The comparative advantage of grain production in the northern plains," unpublished M.Sc. thesis, University of Saskatchewan, 1986.

advances are not widespread in Canada, but there is the potential to increase production in this country by 20 per cent through ICM technology.[3]

Consumption Technology

Over the period 1986-88, there have been some significant changes in the pattern of wheat consumption. The changes in milling technology have altered the use of white wheats, while gluten washing enables lower-protein wheats to be used in the production of breads. All of these changes are part of the dynamics of the world's wheat economy.

New varieties of white wheats that are more resistant to sprouting have the potential to become economically important on the Prairies. Many countries whose milling technology is unable to sort the bran from the flour have a preference for white wheats. The market is substantial and could be an important diversification for Canadian producers in the future.

Wheat is unique among cereals in that it contains protein gluten, which, when combined with water, becomes an elastic substance that enables the production of leavened bread. Gluten can be extracted and used to upgrade low-protein wheat. This use of gluten in breadmaking has the potential to reduce the demand for high-protein wheat. Such technology, now being used in Europe, permits the substitution of low-quality wheat for high-quality wheat in breadmaking. The process coincides with the price spreads between high- and low-protein wheats. In the United Kingdom, where gluten is used, low-quality wheat is priced near the level of high-quality wheat. Should that spread widen, the use of gluten in breadmaking would increase.

The use of wheat for animal feed is increasing around the world. Canada is a late player in that market but is now starting to catch up, with the development of new classes of spring wheat. This is a large, potentially profitable market.

The use of wheat for animal feed is very sensitive to price changes in the wheat and corn markets. Wheat is used in poultry feed rations, and because poultry demand is increasing, the market for wheat is quite promising. The main effect will be on the feed-wheat market.

Animal Feed

Corn is the dominant feed throughout the world; in western Canada, however, barley is the most important feed grain. Barley – and, to a lesser extent, wheat – competes with corn in animal rations. In periods of oversupply, feed users will bid for the grains so that the feed-value differential equals the price differential. In other words, the animal-feed market sets the floor price for Canadian wheat and barley.

Corn yields in the United States have increased rapidly over the past 25 years. This yield change in corn has put pressure on the feed-barley market. Increases in the barley yield have been the most rapid in the European Community (see Chart 2-4). This increase has occurred because of the movement toward winter-barley varieties, which are higher-yielding, and the use of ICM technology.

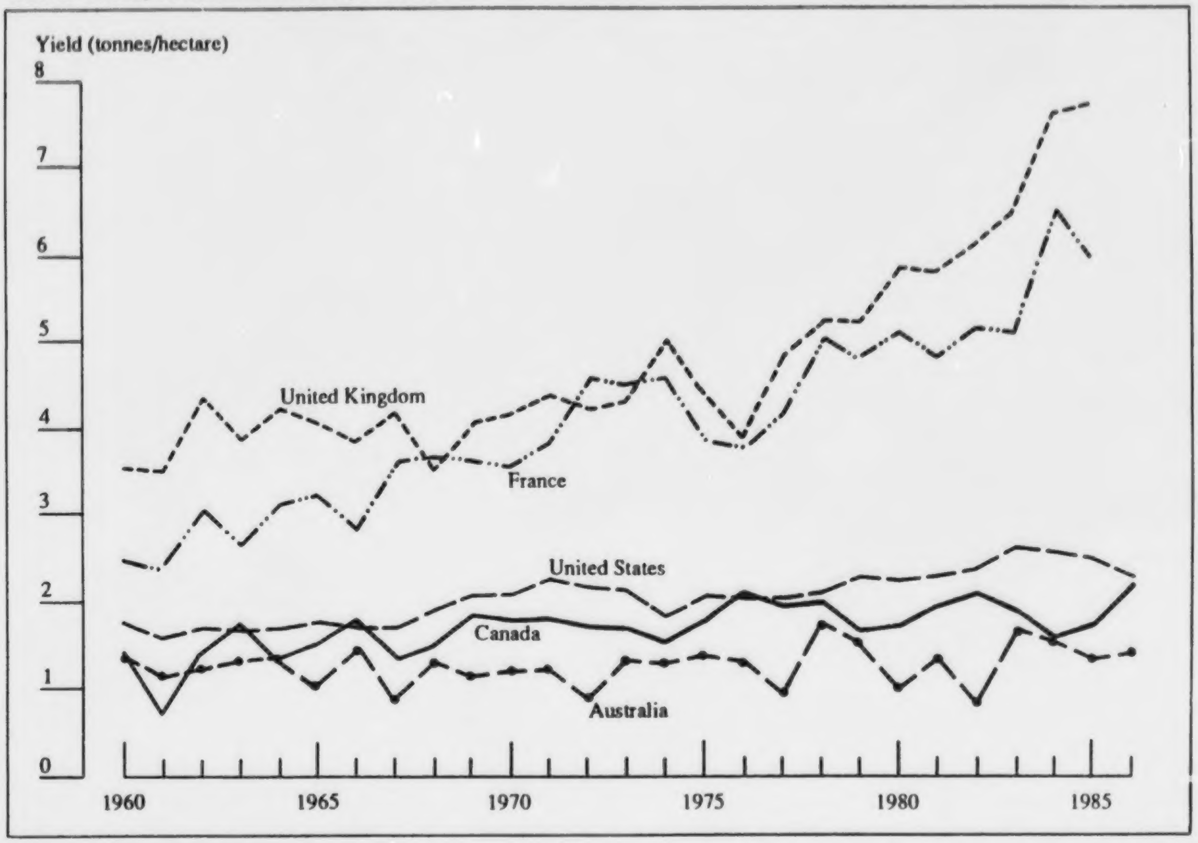
Yield increases in corn will be more difficult to achieve in the future than they were in the past. Increased use of fertilizer could result in higher yields, but the benefits from hybridization have already been captured.

The Grain Handling and Transportation Systems

The grain economy of the Prairies is influenced by the transportation system in a number of ways. First, there is the payment to the railways for shipping grain from the Prairies to export position. Second, of the western ports, Vancouver is becoming increasingly important to Prairie producers. Finally, the Government of Canada has allowed variable freight rates, which in the long run may have a great influence on the location of elevators and on the future rail network. This could have a further influence on town viability.[4]

Chart 2-3

Wheat Yields, Selected Countries, 1960-86



SOURCE Canadian Grains Industry, *Statistical Handbook, 1975* and *1985*; U.S. Department of Agriculture, Foreign Agricultural Service, *World Crop Production*, Circular Series WCP-4-87, April 1987; and Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues.

First, if the payment were made to the farmers directly rather than to the railways, the price of grains on the Prairies would drop by approximately $30 per tonne. This reduction in price would have a significant impact on the production mix of Prairie grains; it would encourage high-valued crops (such as oilseeds) and discourage crops (such as barley and feed grains).

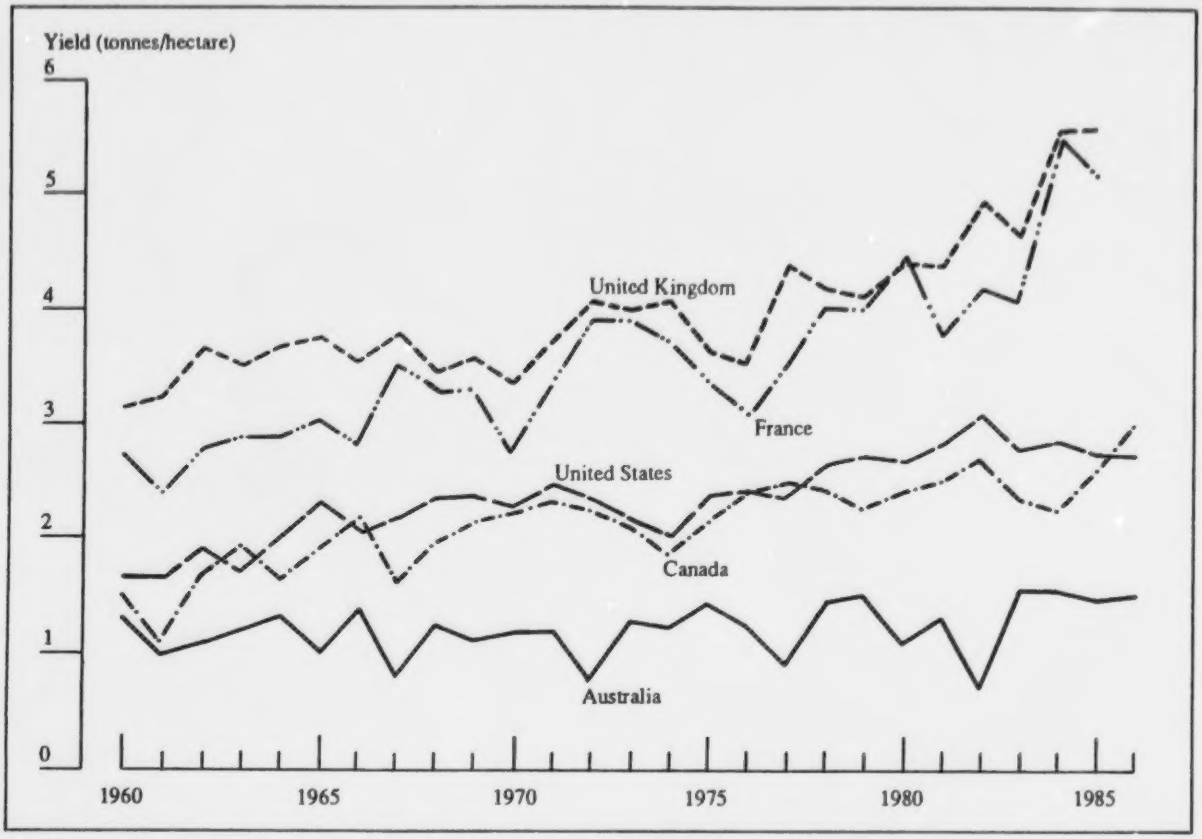
Second, the emergence of Vancouver as the preferred port results in the price of wheat and barley being higher in the Pacific region than at Thunder Bay (except for durum wheat), largely because of the expensive transportation system from Thunder Bay through the Seaway to the St. Lawrence. The Canadian Wheat Board is aware of that change, but the freight structure on the Prairies does not yet reflect this new reality.[5]

As the transportation system starts to reflect the economic advantage of shipping through the Pacific ports, there will be opposition from those with a vested interest in maintaining the movement of grains through Thunder Bay. Given that the Pacific markets are growing and that those of Europe are declining, however, more grain will be moved through the West Coast ports.

Third, the federal government has opened up the issue of branch-line abandonment with the introduction of variable freight rates. In the 1987/88 crop year, the Canadian National Railway will be able to offer low-cost freight rates to elevator companies at specific points. These economic incentives should increase the rate at which elevator companies close their smaller, inefficient elevators.[6]

Chart 2-4

Barley Yields, Selected Countries, 1960-86



SOURCE Canadian Grains Industry, *Statistical Handbook, 1975* and *1985*; U.S. Department of Agriculture, Foreign Agricultural Service, *World Crop Production*, Circular Series WCP-4-87, April 1987; and Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues.

The variable-freight-rate issue and rail-line abandonment are closely related. The railways are clearly concerned with high-cost branch lines and have applied to the Canadian Transport Commission to abandon a number of lines. In the next 10 years, the number of elevators and miles of rail line in the Prairie region will decrease significantly, as has happened over the past 15 years.

Transportation policy is paramount to the health of the grain economy of the Prairies. The struggle by domestic feed users over the export grain payment will continue. At the same time, the railway, elevator companies, and producers must agree on how the transportation network will operate. Only with that type of agreement will the grain transportation system reach its full potential for Prairie farmers.

Government Programs

The federal government has put in place policies that affect the final price that farmers receive for their grain crops. These were initiated under the *Western Grain Stabilization Act* and the Special Canadian Grains Program.

The WGSA was introduced by the federal government in 1976 to stabilize the net returns to grains sold into the export market from the Prairie region (it does not include grains produced and fed on farms). The plan is financed by contributions from the farmer and the federal government. For each dollar that the farmer puts into the fund, the government puts in two dollars. The schedule of payments to date is shown in Table 2-2.

Table 2-2

Government Payments to Grain Producers, Prairie Provinces, Crop Years 1970/71 to 1987/88

	WGSA payments	Crop insurance payments
	($ Millions)	
1970/71	---	3.60
1971/72	---	5.90
1972/73	---	10.68
1973/74	---	29.75
1974/75	---	69.97
1975/76	---	48.56
1976/77	---	72.47
1977/78	113.90	56.50
1978/79	251.40	138.95
1979/80	---	223.57
1980/81	---	137.94
1981/82	---	184.06
1982/83	---	236.36
1983/84	229.52	406.16
1984/85	521.65	563.18
1985/86	859.00	---
1986/87	1,400.00*	---
1987/88	1,340.00*	---

--- No payout.

* Estimate only.

SOURCE Statistics Canada, *Agriculture Economic Statistics*, Cat. 21-603E, various years.

The SCGP is not a permanent policy but a legislation that was to provide a special deficiency payment to producers for their 1986 and 1987 crops. In October 1986, the federal government announced a $1-billion deficiency-payment program for grains (the SCGP). Of that amount, approximately $800 million will go to farmers in the Prairie region. The payment for the 1987 crop was $1.1 billion.

Even though the objective of government policy is to stabilize the net returns to grain producers, because of the uncertainty of the policy regarding deficiency payments, such action has become destabilizing. Producers base their crop decisions on their expectations of what action the government will follow. Unless the government gives clear, consistent signals to farmers, it will further destabilize the agricultural sector.

Conclusions

Prairie farmers must contend with natural constraints such as weather and soil conditions, and with federal and provincial government policies, as well as international politics and the policies of foreign governments. It is not surprising, then, that grain farmers on the Prairies feel their future is beyond their control.

Canadians have put into place a number of important institutions (such as the Canadian Wheat Board) to help farmers deal with the uncertainty of world markets. Government intervention is welcomed by some farmers; others prefer to be free of government regulations and marketing agencies. In the case of canola/rapeseed, the Winnipeg Futures Market is the one institution that is important to those producers.

In forecasting the future of the Prairie grain economy, all of the technological forces at work in consumption and production must be taken into account, as well as government policy. Because the United States is the dominant player in the U.S. market, many of our forecasts are dependent on U.S. farm policy. Canadian farm policy is, of course, very important to Canadian grain producers; however, it has only a minimal impact on the world's grain markets. The importance and role of Canadian farm policy is discussed in an Economic Council study by Fulton, Rosaasen, and Schmitz.[7]

3 The Wheat Economy of the World

Wheat is the major grain crop in the world, in terms of both area planted and quantity produced. Wheat is also the one food item that is traded so extensively. In 1984/85, 102 million tonnes of wheat were traded out of a total world production of 521 million tonnes.

Wheat can be grown in a wide variety of climates and soil conditions, but it is most suited to the temperate climates of the world. With the exceptions of Australia and Argentina, wheat is grown mostly in the northern hemisphere, between 30° and 60°N latitude. Although the United States, the European Community, and Canada are presently the most influential wheat-exporting countries, their total production constitutes less than a third of the world total. The Soviet Union and China are presently the largest wheat producers in the world. The Soviet Union has the largest seeded area – approximately equal to the seeded areas of the United States and the European Community combined. As shown in Table 3-1, however, almost all wheat exports originate in developed countries, where wheat consumption is relatively stable and wheat production per capita is high compared with wheat consumption per capita.

As of 1985, developed countries produced 50.1 per cent of total wheat output and consumed only 39.6 per cent of the total amount utilized, whereas these ratios for developing countries were 26.9 per cent and 33.8 per cent, respectively (see Table 3-2).

The 1960s and 1970s witnessed major changes in the wheat economy of the world. Wheat production rose from 224.8 million tonnes in 1961/62 to an estimated 499.2 million tonnes in 1985/86 – an increase of 122 per cent. During the same period, the wheat consumption of the world rose from 236.4 million tonnes in 1961 to 487.6 million tonnes in 1985 – an increase of 106 per cent. The volume of world trade increased by 81 per cent, from 46.8 million tonnes in 1961 to 84.6 million tonnes in 1985.

The two most important factors explaining the increase in consumption are population growth and growth in per-capita income. The world population doubled from 2.5 billion in 1950 to 5 billion in 1981; even with no change in per-capita consumption, this implies a doubling of total consumption. Growth in per-capita income, particularly in

Table 3-1

Worldwide Wheat Production, Consumption, and Trade, Selected Major Areas, 1985

	Production	Consumption	Trade	
			Exports	Imports
		(Millions of tonnes)		
Argentina	8.50	4.40	4.30	–
Australia	16.17	2.73	16.03	–
Canada	24.25	5.58	17.68	–
China	85.81	92.41	–	6.60
Eastern Europe	36.97	37.97	2.28	2.91
European Community	71.62	59.44	27.78	15.33
India and Pakistan	55.77	56.52	0.46	1.99
Soviet Union	78.10	91.60	0.50	15.70
United States	66.00	28.47	24.90	0.45
World	499.24	487.57	95.96	94.65

SOURCE U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987, and *World Agricultural Supply and Demand Estimates*, WASDE-209, September 10, 1987.

Table 3-2

Distribution of World Production and Consumption of Wheat, Selected Regions, 1985

	Production		Consumption	
	(Millions of tonnes)	(Per cent)	(Millions of tonnes)	(Per cent)
Developed countries	250.12	50.1	193.07	39.6
Developing countries	134.05	26.9	165.03	33.8
Soviet Union and Eastern Europe	115.07	23.1	129.57	26.7
World	499.24	100.0	487.57	100.0

SOURCE U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987, and *World Agricultural Supply and Demand Estimates*, WASDE-209, September 10, 1987.

developing countries, enabled people to shift their consumption from inferior-quality grains to wheat, causing a further rise in total wheat consumption. Changes in the relative prices of grains are, of course, important factors explaining the change in consumption patterns. In the case of wheat, however, the relationship between price and consumption is not easy to measure. Many governments control and subsidize the price of bread and wheat, which makes the demand for wheat unresponsive to world market prices.

The only element of the world's wheat demand that might respond directly to market price is the quantity used for animal feed. In the mid-1970s, the use of wheat for animal feed dropped significantly in the Soviet Union and then increased rapidly when prices decreased. The use of wheat as a feed grain will be limited by the extent to which the price of wheat can decline relative to feed-grain prices.

The increase in wheat production springs basically from one source – technological change. The global wheat area harvested increased from 203.5 million hectares in 1961 to 229.3 million hectares in 1985 – an increase of only 12.7 per cent over 25 years. Average wheat yields, on the other hand, increased from 1.1 tonne per hectare in 1961 to 2.18 tonnes per hectare in 1985 – a rise of 98.2 per cent.[1]

The average annual rate of increase in production, consumption, and trade was almost the same between 1961 and 1979. In the early 1980s those rates began to diverge, causing a decline in world trade and an increase in the world's wheat stocks. The average annual growth rates, computed for the two time periods 1961-85 and 1980-85 (Table 3-3), show that during recent years, consumption has failed to keep up with production. As a result, the world's wheat stocks rose by 80 per cent to an estimated 146 million tonnes from 1980/81 to 1986/87.[2] Until 1972, the wheat market of the world was characterized by stable prices, with the f.o.b. export price for #2 HWO (hard, winter, ordinary) wheat in the U.S. Gulf varying between US$58/tonne and US$66/tonne – except during the 1969 price wars. The price of wheat rose from US$60/tonne to US$91/tonne in 1971 and to US$177/tonne in 1973; it started to decline in 1974, and the downward movement continued until 1978. Between 1978 and 1980, the wheat price rose; it peaked at US$182/tonne in the 1980/81 crop year and has been declining steadily ever since.[3]

Some of the factors that created, or contributed to, this instability are as follows: the introduction of high-yielding grain varieties (HYVs) in some developing countries, policy shifts and production instability in the Soviet Union, the implementation of the Common Agricultural Policy (CAP) in Europe, and the appreciation of the U.S. dollar in the early 1980s.

The introduction of high-yielding grain varieties – also referred to as "the Green Revolution" – was the result of

Table 3-3

Change in Worldwide Wheat Production, Consumption, and Trade, Selected Periods, 1961-85

	Average annual rate of change		
	Production	Consumption	Trade
		(Per cent)	
1961-79	3.6	3.6	3.4
1980-85	2.4	1.9	–2.1
1961-85	3.4	3.1	2.5

SOURCE U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

deliberate research carried out by a wide variety of private and public, national and international, research centres. The impetus for such a concentrated research effort came in the late 1950s, with predictions that the world would increasingly face famines if food supplies did not at least keep up with population growth. The adoption of HYVs, combined with increased fertilizer consumption and new agronomic practices, resulted in higher grain yields.

Among the benefits perceived was the possibility of becoming self-sufficient in the production of wheat and other grains, and/or of even becoming a net grain exporter. This had several attractions. First of all, if a nation were self-sufficient in wheat, it would not be so vulnerable to events occurring beyond its borders (e.g., wars, border disputes, the imposition of export taxes or grain embargoes by wheat-exporting nations, changing world wheat prices, or foreign exchange fluctuations). In addition, the technologies of the Green Revolution enabled governments to reduce the need for hard currency to pay for wheat imports and allowed them to raise the income of the farm and input-supply sector while maintaining cheap bread prices in urban areas.

Many governments made new public investments in infrastructure that supported the increased agronomic requirements of HYVs. These included the building of new fertilizer and pesticide plants, roads, storage facilities, and irrigation systems. Increased government expenditures were also forthcoming for expanded government programs in the areas of agricultural credit and education.

These price-support and stabilization programs encouraged production so as to realize the gains made possible by HYV technology. The increased profitability and reduced price instability increased the willingness and ability of farmers to make additional long-term investments in the agricultural sector, and they further increased the long-term potential for higher production of crops such as wheat.

The effects of infrastructure support, combined with pricing and stabilization policies, have been dramatic. Consequently, these types of programs have been adopted by countries as diverse as China, Saudi Arabia, and France. The goal of self-sufficiency in wheat has been reached by many of those nations, and some who were formerly importers – for example, the United Kingdom, Saudi Arabia, and India – have become exporters. The impact of HYVs on wheat production in selected regions and countries is summarized in Table 3-4.

Another destabilizing factor in the wheat market of the world has been the erratic purchasing pattern of the Soviet Union, a major grain importer. Factors such as production instability and policy changes made the volume of U.S.S.R. imports highly unstable, which in turn contributed to the instability of the world's wheat market. Soviet wheat imports ranged from 2.9 to 15 million tonnes between 1972 and 1980.

Until 1971, the Soviet Union was a wheat exporter – mainly to Eastern Europe. The two main factors that were instrumental in its changing from an exporter to an importer of wheat were as follows: 1) in 1970, the shift in Soviet policy whereby, instead of changing its emphasis from consumption to production, it would use international markets to make up for domestic-production shortfalls; and 2) the repeated crop failures in the Soviet Union in the early 1970s. In the 1970/71 crop year, the Soviets had a bad wheat crop, but they managed to maintain consumption by using up their stocks. By the end of the 1971/72 crop year, Soviet wheat stocks were down to 7 million tonnes from 31 million tonnes in 1968/69.[4] In the 1972/73 crop year, the Soviets experienced another bad wheat crop, and with stocks having been depleted, Soviet wheat imports rose to 15 million tonnes from 3.4 million tonnes in 1971/72. As a consequence, that absorbed most of the increase of 15.5 million tonnes in total world exports during that period.[5]

Table 3-4

Wheat Production in Selected Countries of the World, 1961-65 and 1976-80

	Five-year averages				
	European Community	China	India and Pakistan	Turkey	Africa
			(Millions of tonnes)		
1961-65	33.54	22.00	15.40	8.46	6.10
1976-80	47.16	52.64	40.72	16.80	8.80

SOURCE International Wheat Council, *World Wheat Statistics*, London, 1984, pp. 28-29.

In the 1972/73 crop year, other importing countries experienced supply shortfalls as well, when the mid-1970s witnessed the "world food crisis." The major exporters (i.e., the United States and Canada) drew upon their stocks to meet the increased import demand. About the same time, the first oil-price shock was felt, and wheat prices in 1973 reached unprecedented levels.

Another factor that contributed to the wheat-market crisis was the implementation of the Common Agricultural Policy in Europe. As of 1971, the European Community was still a small importer of wheat. The CAP guaranteed to producers the price that was charged to consumers. That policy promoted domestic production in the European Community and also discouraged imports. By the end of the 1974/75 crop year, the European Community had become a net wheat exporter. By 1985, in terms of net exports, it had become the fourth largest wheat exporter in the world (see Table 3-1).

One of the factors that has contributed to the steady decline in wheat prices observed in the 1980s has been the appreciation of the U.S. dollar against many hard currencies. Beginning in 1979, the tight monetary policy pursued by the Federal Reserve Board raised domestic interest rates, which in turn attracted capital inflows and appreciated the U.S. dollar against many hard currencies. The attempts by other countries to stabilize their currency with flexible exchange rates led to a contraction of the world's money supply, resulting in a global recession. Global recession, by reducing the growth in per-capita income, caused the annual rate of increase in wheat consumption to fall below the rates observed in the period of 1961-79 (Table 3-3). The world market for wheat, and for other commodities such as feed grains and cotton, contracted; and world prices, denominated in U.S. dollars, fell. The value and the volume of exports from the United States and those of some other exporters, such as Canada, began to decline.[6] During the period 1980-85, the volume of international wheat trade declined by an average of 2.1 per cent per annum (Table 3-3).

This poses a dilemma for traditional exporters, particularly the United States, which is still, by a wide margin, the largest wheat exporter. Traditionally, the U.S. government has stabilized the income of its wheat farmers by a combination of stock-building and -release programs, acreage set-asides, and price supports. In the past, the price level at which the U.S. government bought and sold stocks (in other words, the loan rate) generally set the world's minimum wheat export price. Not only did those policies help to stabilize the incomes of U.S. wheat farmers; they also helped to stabilize the world's export price of wheat. This stability was further enhanced when Canada – and later Australia – decided to build stocks when prices were low and to increase sales when prices were high. In addition, these three major exporters maintained their wheat export-market shares at a relatively constant level.

With the emergence of increased volumes of wheat exports from non-traditional exporters like the European Community and with their refusal to build stocks when export prices are depressed, the traditional exporters have seen the collapse of price stability in the world's wheat market. If the United States maintains a high loan rate, its export share will be increasingly eroded by newly emerging exporters who are able to price just below the loan rate; if the United States drops the loan rate in an attempt to regain market share, it will cost the U.S. Treasury increasingly large amounts because of the farm subsidies that are triggered when the loan rate drops below the estimated U.S. farm costs of production. In addition, a drop in the loan rate will not necessarily lead to an increase in the U.S. market share because of the previously noted determination of non-traditional exporters to export, at any price, any volume that is over and above their domestic needs. The changes in the market shares of major exporters from 1965 to 1985 are shown in Table 3-5. The result, from Canada's point of view, is increased price instability in the wheat market of the world.

Country Assessments, 1960-95

As noted in Chapter 1, there is a certain correlation between wheat prices and stock levels. The objective of this chapter is to forecast the world's wheat stocks and stock/use ratio to the year 1995 and, through the aforementioned relationship, try to predict the future direction of the world's wheat price. The world's wheat stocks, in this respect, are evaluated as the difference between production and consumption. Projections of the world production and consumption of wheat and forecasted stocks are reported in the following section.

The past performance and future projections for the major wheat-producing and -consuming countries are reported individually. Three sets of projections were made: base-, high-, and low-case scenarios. Only the results of the base-case scenarios are reported in the tables.

Canada

Production — Canada has made its mark in the world as a region that has produced surplus wheat since the start of the twentieth century. To this day, almost all of Canada's

Table 3-5

Market Shares of Major Wheat and Flour Exporters, Selected Countries, Crop Years 1965/66 to 1986/87

	Argentina	Australia	Canada	United States	European Community	Others	Total exports[1]
			(Per cent)				(Millions of tonnes)
1965/66	12.6	9.0	25.2	37.2	8.7	7.3	63.02
1966/67	5.6	12.7	25.4	36.6	7.6	12.1	55.09
1967/68	2.6	13.6	17.7	39.7	8.4	18.0	51.66
1968/69	6.1	11.8	18.2	32.9	11.0	20.0	45.60
1969/70	4.1	14.1	18.3	32.7	13.9	16.9	51.39
1970/71	3.1	17.3	21.5	36.7	5.7	15.7	54.85
1971/72	2.5	16.6	26.1	32.2	8.9	13.7	52.50
1972/73	5.2	8.2	23.0	46.6	9.6	7.4	68.05
1973/74	1.8	8.7	18.1	49.8	8.7	13.0	62.98
1974/75	3.5	12.8	17.1	45.0	11.3	10.3	62.95
1975/76	4.6	12.1	18.4	47.4	11.6	5.9	66.87
1976/77	9.0	13.5	21.6	42.1	6.3	7.5	62.01
1977/78	3.7	15.3	22.1	43.5	6.2	9.2	72.54
1978/79	4.6	10.2	18.4	45.4	10.3	11.1	71.20
1979/80	5.4	17.6	18.1	42.5	11.7	4.7	87.53
1980/81	4.2	11.9	17.5	45.0	13.6	7.8	93.15
1981/82	4.2	11.3	18.3	48.4	13.9	3.9	100.88
1982/83	7.7	8.8	22.0	41.2	14.5	5.8	97.02
1983/84	9.5	11.4	21.4	38.3	14.8	4.6	101.50
1984/85	7.8	14.8	17.2	37.4	16.6	6.2	101.92
1985/86	7.2	18.9	19.9	29.6	18.4	6.0	84.60
1986/87	4.7	16.2	22.0	31.1	17.9	8.1	91.30

[1] Total exports from July to June, except for Canada, where they are from August to July.

SOURCE Canadian Wheat Board, *Annual Report, 1985/86*; 1986 estimates from the International Wheat Council, *International Wheat Statistics*, 1986; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

wheat is grown in the Prairie region of western Canada. The climate and soil conditions favoured the production of high-protein wheat, barley, oats, and flax. Wheat has been the dominant export crop from western Canada because it generally returns the highest prices to farmers. As shown in Table 3-6, wheat production continued to increase from 1919 to 1985, primarily through higher yields.

The government of Canada has been heavily involved in the wheat economy in its attempts to increase exports. One of the most obvious programs is the subsidized freight rates for western grain to Thunder Bay and Vancouver, called the Crow's Nest Pass rates. These rates were put in place to protect farmers from increased rail costs in exporting their crops. Because the freight rates remained unchanged from the early 1920s till the end of 1982, when a new *Freight Rate Act* was passed, it was estimated that farmers received $650 million in freight subsidies in 1982. The largest portion of that subsidy went to wheat, since wheat accounts for most of the export volume. In addition to this freight subsidy, various levels of government have also been involved in the development of roads, railroads, irrigation, and other facilities to aid grain exports from western Canada. A number of pricing policies and input subsidies have been used by the governments to increase the quantities of crops exported. The *Western Grain Stabilization Act*, the Crop Insurance Program, and the Special Canadian Grains Payment of 1985/86 are all direct government programs aimed at subsidizing farmers. All of these programs encourage farmers to produce more grain, primarily for export. Over

Table 3-6

Wheat Production in Canada, 1908-85

	Eleven-year averages		
	Area worked	Production	Yield
	(Millions of hectares)	(Millions of tonnes)	(Tonnes per hectare)
1908-19	4.75	5.78	1.22
1919-30	8.92	10.01	1.12
1930-41	10.49	9.51	0.91
1941-52	9.50	10.89	1.15
1952-63	9.87	13.27	1.34
1963-74	10.18	16.59	1.63
1974-85	11.27	21.05	1.87

SOURCE A. B. Campbell and L. Shebeski, "Wheat in Canada – Past and present," in *Wheat Production in Canada – A Review*, eds. A. E. Slinkard and D. B. Fowler, Division of Extension and Community Relations, University of Saskatchewan, 1986.

the years, the government has subsidized the interest rates on loans to the Farm Credit Corporation, has given farmers special tax considerations on the use of farm fuels, and has introduced rapid depreciation rates for machinery. These programs have all been aimed at increasing farm incomes, but at the expense of the taxpayers.

Government agriculture policies have usually been aimed at the inputs used or the quantities produced. This has often led farmers to plant their crops in response to government programs rather than in response to signals from the marketplace. Wheat producers in 1987 received a large payment from the *Western Grain Stabilization Act* (approximately $1 billion). Farmers will be encouraged to grow as much wheat as possible in order to achieve the maximum payout under this program. At a time when market signals are suggesting that farmers should cut back production, government programs are encouraging production, because participation is very important in determining the level of payout. This confusion is one of the major problems with government policies.

In the "most likely" scenario, it was assumed that there would be no change in government policies until the world stock/use ratio went down to 20 per cent. In Canada, the most likely outcome, assuming that the wheat price will remain around US$81/tonne until world stocks are driven down, is that wheat production will fall to 23 million tonnes and remain at that level over the projection period. This scenario assumes that low wheat prices will discourage investment in that sector and cause depreciation in capital to such an extent that it will offset any gains from new varieties or other cost-efficient technologies.

In the low-production scenario, it was assumed that the federal government would make a direct payment of the US$16/tonne transportation subsidy to producers rather than to the railways. The resulting drop in the grain price then decreases production to 22 million tonnes.[7] In the high-production scenario, it was assumed that government support programs would continue and would offset the impact of low prices on production; hence the 1986 production trend of 25 million tonnes will be maintained, with no growth in the future until prices increase. Based on the model presented in Appendix B, we also evaluated the potential impact of removing all government subsidies on production, in which case wheat production in Canada could be expected to decline to 20.6 million tonnes, with no further growth.

Consumption — In Canada, wheat is utilized both as food and as animal feed. As of 1985, 31 per cent of all wheat consumed domestically was utilized for feed. The estimated income elasticity of demand for wheat consumed as food is –0.24; and for feed, 0.04. As per-capita income rises, the use of wheat for food is expected to decline, from 135 kg/person in 1986 to 131 kg/person in 1990 and 128 kg/person in 1995. Because of the positive income elasticity, however, the per-capita wheat used for animal feed is expected to rise. These two factors, together with population growth, cause a small increase in total wheat consumption, from 5.7 million tonnes in 1985 to 5.9 million tonnes in 1990 and 6.2 million tonnes in 1995.

Trade — Canada exports 65.85 per cent of its annual wheat crop, but in some years that ratio goes even higher (in 1971/72, for example, Canadian wheat exports amounted to 95 per cent of that year's production).[8] The ratio of exports to annual production has been fairly stable over the last two decades; however, the Canadian share of the world market has declined steadily during the same period. Annual Canadian exports accounted for nearly 39 per cent of the world's trade volume in 1952/53, but the late 1950s witnessed a sharp decline in our market share. Between 1959 and 1963, the Canadian market share leveled out at 21 per cent and has been declining ever since, except for two years. As of 1984, the Canadian market share was at a historically low 17 per cent.[9] Parallel to the projected decline in production and the increase in domestic consumption, the Canadian export supply is expected to fall to 17.2 million tonnes in 1990 and to 16.9 million tonnes in 1995.

Production, consumption, and trade projections are reported in Table 3-7.

Table 3-7

Projected Wheat Production, Consumption, and Trade in Canada to 1990 and 1995: The Most Likely Scenario

	Actual,	Projected	
	1985	1990	1995
	(Millions of tonnes)		
Production	24.3	23.1	23.1
Consumption	5.7	5.9	6.2
Trade[1]	17.8	17.2	16.9

1 The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

United States

Production — Wheat production in the United States is concentrated on the Great Plains of North America, which span the central region of the country from Texas to North Dakota. The remainder of the wheat production occurs in the Palouse region of the northwestern United States and over a broad area of eastern United States.

The widespread area of production and range of climates have led to very stable yields. From 1970 to 1982, the average variation in the U.S. wheat yield was less than 5 per cent.[10] Thus the chance of suffering a major loss in production in that country because of weather is quite small.

Wheat yields in the United States have shown steady growth; they increased from just over 16 bushels per acre in 1950-52 to over 36 bushels per acre in 1981-83. These increases have been largely achieved by the adoption of higher-yielding semi-dwarf varieties and an increase in fertilizer and herbicide use.

Unlike yields, the harvested acreage of wheat has not shown a steady pattern of growth. From 1950 to 1954, the wheat area averaged 63 million acres, while from 1960 to 1964 it declined to 48 million acres. In 1981, it reached 80 million acres but subsequently declined to 61 million acres in 1986. These fluctuations in harvested acreage have, in part, been caused by government policy. The overall growth in the harvested area has been due to the increase in the southeastern area, which is double-cropped. This change in agronomic practice – whereby wheat is double-cropped with soybeans – has obvious advantages to producers, including more-efficient use of fixed resources and increased returns. Double-cropping is likely to continue to increase, offsetting some of the government's efforts to reduce production.[11]

The United States dominates the export market for wheat. In 1981/82, U.S. exports of 48 million tonnes made up 48 per cent of the world's wheat trade. Since 1981, however, U.S. exports have declined, having fallen to less than 25 million tonnes in the 1985/86 crop year, resulting in a large build-up of U.S. stocks. In response to that situation, the U.S. government passed the *Food Security Act* of 1985, which had a dramatic effect on prices and production. In order to assess the future of the U.S. wheat economy and its impacts on the world, it is necessary to understand the structure of the U.S. wheat sector and government policy.

The U.S. farm policy was designed with many objectives – namely, to support income, to support prices, to control production, and to enhance exports. The primary means of income support is the deficiency payment. If the average market price is below the target price, the farmers receive the difference in the form of a deficiency payment. These deficiency payments have been variable and have tended to stabilize farm income in periods of depressed prices; however, they have also become somewhat of a fixture in U.S. agriculture.

The 1985 *Food Security Act* set the target price for the 1986/87 and 1987/88 crop years at $4.38/bushel, to decrease 2 per cent in 1988, 3 per cent in 1989, and an additional 5 per cent in 1990. If market prices remain depressed, deficiency payments will remain large.

To support the market price, the U.S. government maintains stock-holding and production-control programs. The stock-holding policies include the Nine-Month Loan Program and the Farmer-Owned Reserve. The production-control programs include the Acreage Reduction Program and the Soil Conservation Reserve.

The Nine-Month Loan Program is a program designed to take grain off the market and place it in storage when grain prices fall below a predetermined level, called the loan rate. The program is voluntary and applies to wheat, feed grains, and soybeans. In order to be eligible for the program, producers must participate in any acreage-reduction scheme that the government might have in place for that year. After a producer has harvested the crop, it may be used as collateral to obtain a nine-month loan immediately. The size of the loan is equal to the loan rate times the number of bushels produced. If, at any time, the market price rises above the loan rate, the producer can simply sell the grain and pay off the loan, plus any interest that has accrued. If the market price does not exceed the loan rate during the nine months in which the farmer holds the loan, the farmer can simply turn the grain over to the government and keep the principal amount of the loan; or the producer can enrol the grain in the Farmer-Owned Reserve. This program has had the effect of holding large amounts of U.S. wheat and corn off the market during times of depressed prices. In the past 35 years, the U.S. farm prices for wheat have deviated from the loan rate only twice. In both of those periods, world stocks fell below 20 per cent of the world's annual use, and buyers bid the price up much higher than the loan-rate price.

The other storage program that the U.S. government operates is called the Farmer-Owned Reserve. It is similar to the Nine-Month Loan Program except that the grain is stored for a longer period; farmers are paid 26.5 cents/bushel per year to store the grain; and once enrolled in the Farmer-Owned Reserve, the grain cannot be sold until a release price is reached. That has the effect of locking the grain off the market until those stocks are drawn upon. This release price can act as a price ceiling for the grain market. When the release price is reached, a large amount of grain is then available for sale.

The Acreage Reduction Program in the United States gives the Secretary of Agriculture authority to require that all producers who wish to receive program benefits reduce their seeded acreage in order to be eligible. In order to reduce production and to protect highly erodible lands, the 1985 *Food Security Act* also introduced the Soil Conservation Reserve. That program establishes a maximum of 45 million acres of cropland and a minimum of 40 million acres to be placed in the Reserve by 1990. For the 1987 crop year, 20 million acres will be in the program. The amount that the program will reduce wheat acreage is uncertain, given that the specific acres are decided by a bidding procedure among producers. Whether this reduction in production offsets the effects of the supply-enhancing policy remains an empirical question.

Government expenditure on agricultural research over time increases yields and reduces production costs, shifting the supply curve to the right. The increased farm returns at the target price clearly increase production on seeded acres. While the 1986 deficiency payments were based only on historical yields, the 1987/88 to 1990/91 base yields will incorporate yield increases for those years. This will provide an incentive to maintain and increase yields at the point where marginal cost is equal to the target price rather than the loan rate.

The U.S. farm policy also affects the demand for wheat. The Nine-Month Loan Program and the Farmer-Owned Reserve clearly create a demand for U.S. wheat when prices fall below the loan rate – and decrease the demand when prices are higher – thus having a stabilizing effect on the market.

The magnitude and the impact of the U.S. programs should not be underestimated. The United States is one of the largest producers and exporters of wheat in the world, and the U.S. policies respond to world market conditions. As a result, the U.S. government can have a large impact on the world's grain sector. Recently, that was made very apparent with the introduction of the 1985 *Food Security Act*. The Act lowered the price by 30 per cent and had a severe impact on the value added and on farm incomes in grain production throughout the world. The U.S. agricultural policy will continue to have a pervasive influence on the world's grain markets.

In the United States, the most likely prospect is that the current policies will continue to generate 61 million tonnes of wheat per year, with no growth. In the low-production scenario, it is assumed that U.S. production will decrease by a further 10 per cent to 55 million tonnes, via increases in the Acreage Reduction Program and the Soil Conservation Reserve. In the high-production scenario, it is assumed that the United States will remove some of the programs and reduce the Acreage Reduction Program, to increase production by 10 per cent to 67 million tonnes. An alternative scenario is the removal of all programs targeting wheat production. In that case, U.S. production is expected to increase by 18 per cent to 75 million tonnes.

Consumption — In the United States, the per-capita use of wheat for food will go down to 86 kg in 1990 and to 85 kg in 1995, from 88 kg in 1986. The use of wheat for feeding is rather limited but quite variable, and it depends on a coarse-grain situation as well as a wheat surplus. When wheat prices were high, as in 1975, the amount of wheat used for feed declined to below 1 million tonnes. In 1986, because of the abundant stocks, estimated wheat feeding increased to about 10 million tonnes – one-third of domestic consumption. Historically, a drop of 1 per cent in the price of wheat vis-à-vis that of corn increased wheat feeding by 3.5 per cent. Seed use in the United States is light and stable, amounting to less than 3 million tonnes. As of 1986, wheat used for feed amounted to 36.5 kg per capita, and that is expected to rise to 36.6 kg in 1990 and to 36.8 kg in 1995; total consumption is projected to rise to 30 million tonnes in 1995 from 28.4 million tonnes in 1985.

Trade — The United States has historically been the largest wheat exporter. During the early 1970s, U.S. exports – both in volume and as a percentage of world trade –

increased steadily, from 16.8 million tonnes in 1969 to 31.3 million tonnes in 1973, causing the U.S. market share to jump from 32.7 per cent to an all-time high of 49.8 per cent. The major reason for this doubling-up of U.S. exports was the poor wheat crop in the Soviet Union, which forced the latter to enter the international markets as a large importer. The United States maintained its market share of around 42 to 47 per cent all through the 1970s. In the 1981/82 crop year, the U.S. market share peaked again at 48.4 per cent but then started to decline and fell to 29.6 per cent in 1985 (see Table 3-5).

In 1985, in order to regain its market share, the U.S. government introduced an Export Enhancement Program, which is also referred to as the Bonus Incentive Commodity Export Program (BICEP). Under that program, the Commodity Credit Corporation can offer payment-in-kind certificates for export companies who sell into targeted markets: a "buy two, get one free" type of incentive. This program allows the U.S. companies to sell wheat into foreign markets below the U.S. domestic prices. When the program was originally introduced, it was targeted only at those countries to which the European Community was selling at prices below its domestic price. Over time, the program has expanded and has been used in more markets. In April 1987, the program was used to sell 4 million tonnes of grain to the Soviet Union at nearly $1.00/bushel less than the U.S. export price.

In the most likely scenario, the volume of exportable surplus produced in the United States is projected to decline to 32.1 million tonnes in 1990 and to 31.3 million tonnes in 1995. The change in the U.S. market share will depend very much on the success of BICEP and on the competitive reaction to it. In response to the projected decline in the world's wheat stocks, if the United States moves up to high production in 1994, the volume of exportable surplus is expected to return to its 1985 level. The results of the most likely scenario are reported in Table 3-8.

Table 3-8

Projected Wheat Production, Consumption, and Trade in the United States to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	66.0	61.2	61.2
Consumption	28.4	29.1	29.9
Trade[1]	24.9	32.1	31.3

1 The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

European Community

Production — The wheat area of Western Europe has been among the most productive in the world; despite that productivity, however, Europe developed a dependency on grain imports in the twentieth century. In recent years, under the Common Agriculture Policy of the European Community, wheat production has grown rapidly. That has changed the 12 members of the European Community from being net importers of wheat in the early 1970s to being net exporters of over 15 million tonnes of wheat by the mid-1980s. In order to analyze how the current low wheat prices will affect the trade position of the European Community in the future, it is important to examine the physical aspects of European agricultural production; more importantly, it is essential to understand the CAP and how it may affect trade in the future.

France is by far the largest producing member of the European Community, followed by the United Kingdom and West Germany. The climate of the European Community, particularly in the Paris basin and in the eastern counties of the United Kingdom, is humid and cool, and the growing season is long, making those areas ideal for producing high yields of wheat under systems of intensive cereal management. Southern Europe is warmer and dryer; therefore the yield potential is more limited. In 1985, the average yields for Italy, Greece, Spain, and Portugal were all less than three tonnes per hectare, while the remaining countries all had average yields of over six tonnes per hectare. The average yield for the whole wheat area of the EC-12 is 4.69 tonnes per hectare, or 69 bushels per acre, which is double the U.S. average.

Food security has always been a priority of agricultural policy in Europe. This drive for self-sufficiency has come from the repeated experiences of food shortages during the numerous wars of the past. As a result, the agricultural policies of Western European countries have become very protectionist in nature. In the 1950s, it was apparent that there was a need for liberalization of trade within a wide range of goods across Western Europe, and an economic union was proposed.

In 1957, the Treaty of Rome was signed by the six original members of the European Community. The five objectives of its agricultural policy were: increased productivity; a fair standard of living for the farm population; stable markets; security of supply; and reasonable prices for consumers.[12] In December 1963, the essential elements of the CAP were introduced in the original six countries. In the beginning, only six commodities were covered by the CAP. Since that time, the European Community has expanded to 12 members, and the CAP has expanded to cover virtually all agricultural commodities.

After implementation of the CAP, the European Community, by maintaining its prices at levels higher than the world prices, succeeded in increasing productivity and supporting farm incomes. These higher prices have been maintained by imposing tariffs on imported commodities and by offering export subsidies to remove surpluses from the European market. The cereals policy of the CAP has been operating by using a set of prices determined each year by the European Commission.

In addition to this broad form of price support, the CAP has taken steps to increase further the price of bread wheat and pasta-quality durum. There is a "reference price" that is set well above the intervention price for common wheat. This policy is designed to encourage the production of bread wheats, but it has also spawned the development of a gluten-washing industry to enrich the flour quality of softer wheats. In the case of durum wheat, the producers receive a direct payment of just over $50/tonne in addition to other price supports. In the 1986/87 crop year, the European Community's support price was US$284/tonne – almost three times the export price.

Wheat prices in the European Community have been maintained well above the world price, except for the 1974/75 crop year when world prices rose very quickly and actually exceeded the EC price. Since 1968, prices in the European Community have averaged 35 per cent above the world price. The major price drop in 1986, combined with the reduction in the value of the U.S. dollar, meant that in the 1986/87 crop year, the EC intervention price for common wheat was 170 ECU/tonne, or US$160/tonne, which is close to double the world price. These high support prices, combined with the development of new technologies such as semi-dwarf wheat, pesticides, and growth regulators, have given the producers the incentive to adopt ICM techniques, leading to a substantial increase in production.

As a result, total wheat production in the 12 member states has shown tremendous growth. Total production increased from the 32.3 million tonnes in 1961 to 41.2 million tonnes in 1970, to 61.5 million tonnes in 1980, and to an all-time high of 82.9 million tonnes in 1984.

Continuation of the CAP is not in question in the foreseeable future. The CAP is far more than an agricultural policy to the Europeans. It is a secure food policy; a welfare program; and, most of all, an integral part of the European Community. The recent moves by the United States to decrease the world price are unlikely to have a major impact on the commitment to support agricultural incomes. One possible result of the current world-trade situation might be that the European Community would start imposing quotas on cereals production. If that were to occur, it would reduce the growth of production, and exports might stabilize at or near their present level. It is also apparent that the European Community will continue to strive for self-sufficiency in those agricultural products which it currently imports. That will eventually eliminate any remaining imports of bread wheat over the next few years.

The recent accession of Spain and Portugal is likely to have a very small impact on wheat production, for the simple reason that Spain has had a system of supports and prices parallel to the CAP for several years.

In the European Community, where producers are isolated from the world price, the most likely prospect is that some growth in production will continue, but it will be at one-half the rate of the 1961-86 period. In the low-production scenario, it was assumed that production in the 10 EC countries would be frozen, through quotas or lower prices, and that Spain and Portugal would experience the same trend as that experienced by the European Community in the 1961-86 period. In the high-production scenario, it was assumed that the European Community would continue to experience growth at the 1961-86 rate. If it were to remove all programs, wheat production could be expected to stabilize at 68.4 million tonnes per year.

Consumption — In the European Community, wheat consumed as food is expected to decline from the 111 kg/person in 1986 to 106 kg/person in 1990 and to 101 kg/person in 1995 – with the exception of Spain, where a slight rise in consumption is expected. Substantial quantities of wheat are used for animal feed in the European Community because of the availability of lower-quality wheat and high tariffs on feed-grain imports.

The European Community will soon have to take some measures to deal with the huge and expensive cereals surplus, either through the price mechanism or by direct controls. The use of wheat for food is not likely to increase, even if prices were to be substantially reduced; however, there is room to increase the use of wheat for feed. Some steps towards solving the EC cereals-surplus problem were taken by the Council of Ministers in April 1986. "Specifications

Table 3-9

Projected Wheat Production, Consumption, and Trade in the European Community to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected	
		1990	1995
	(Millions of tonnes)		
Production	71.7	71.8	75.4
Consumption	59.5	58.7	58.3
Trade[1]	12.5	13.1	17.1

[1] The excess supply available for export.

Source Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

for breadmaking wheat are to be tightened, and grain will not be accepted into intervention at all if it does not meet the new, more-stringent quality standards."[13] This will create a larger supply of low-priced wheat in the market, which could be diverted to feed use, but it is difficult to say whether this lower-quality wheat will substitute for imported cereals or for domestic barley.

In the most likely scenario, total wheat consumption in the European Community is expected to decrease from the 59.5 million tonnes in 1985 to 58.7 million tonnes in 1990 and to 58.3 million tonnes in 1995.

Trade — Until 1982, the European Community was a small net wheat importer. Since 1982, the volume of EC wheat exports has exceeded the volume of EC wheat imports, and the difference – or net exports – has been growing. The latter rose from 0.8 million tonnes in 1982 to 12.5 million tonnes in 1985.[14] Assuming that there will be no change in the CAP, the volume of the EC exportable surplus is projected to rise to 13.1 million tonnes in 1990 and to 17.1 million tonnes in 1995.

The projected wheat production, consumption, and trade of the European Community are reported in Table 3-9.

China

Production — China is the largest consumer of wheat in the world and presently competes with the Soviet Union as the world's largest producer. Wheat production in China has increased about fourfold in the last 20 years. This dramatic increase has been due to a number of factors: an increase in the area planted; increased consumption of modern inputs, such as chemical fertilizers; irrigation and improved seed; improvements in production management; and increased use of farm machinery. These developments brought about an impressive growth in wheat production, from 24.7 million tonnes in 1961 to 31 million tonnes in 1970, to 55.2 million tonnes in 1980, and to 85.8 million tonnes in 1985.[15]

In the future, all of these factors will still present opportunities for increased wheat production, but several of them offer much less promise than others. For example, it is doubtful whether any significant new frontier areas remain that could be economically converted into arable wheat acreage. In fact, in recent years the area of newly reclaimed arable land has been less than the area of arable land lost to non-farm uses.

In the last 30 years, the government took a number of steps that greatly emphasized the production of rice and wheat at the expense of coarse-grains like sorghum and corn. The recent increase in demand for livestock indicates that if there is to be any change in policy, it will be in favour of coarse-grain production. This further reduces the likelihood that there will be any significant increase in the area devoted to wheat production.

It is also doubtful whether wheat production can be increased much more through multiple cropping and improved water-control methods such as well drilling and pumping, because the "cropping index" (the annual harvested-area/arable-land ratio) is already one of the highest in the world, and a further large increase in the number of wells in the North China Plain might cause the water table to drop progressively and permanently.

The rise in disposable incomes in China in recent years has been accompanied by a rapidly increasing per-capita consumption of alcohol, tobacco, meat, fish, eggs, dairy products, fresh fruit and vegetables, sugar, and cooking oil. It seems very likely that the Chinese leadership will continue to try to meet almost all future grain requirements through domestic production. To do that, domestic grain production will have to grow by about 3 per cent annually, mostly from increases in yield rather than increases in area.

Future growth will depend even more than in the past on what happens to crop yields. Since wheat, and particularly rice, yields are already high by world standards, China will have to be a world leader in developing new varieties and techniques for rice and wheat if rice and wheat output is to continue to grow at rates comparable to those of the past.

Since coarse-grain yields are somewhat less outstanding than rice and wheat yields, it is likely that, in the future, China will come to depend more on gains in the yield of coarse grains to boost total grain production.

China has experienced dramatic increases in wheat production over the last 27 years. Many people feel that the easy gains in production have been exploited. The most likely scenario is that China will continue to increase production at one-half the 1961-86 trend. In the high-production scenario, wheat production will continue on trend. In the low-production scenario, wheat production in China will stabilize at 90 million tonnes.

Consumption — Over the past decade, there has been remarkable growth in China's wheat production and consumption. It has been estimated that total wheat consumption grew at an annual rate that exceeded 7 per cent between 1970 and 1980, having reached approximately 70 million tonnes in 1980;[16] it kept growing at an annual rate of 6 per cent between 1981 and 1986, to reach an estimated 98 million tonnes in 1986.[17] That makes China the second largest wheat consumer in the world. The quantity of wheat used as animal feed is negligible; most of the increase in total wheat consumption is the result of increased per-capita consumption of wheat as food. The growth rate of the Chinese population was around 3 per cent per year in the 1960s; it declined to 1.2 per cent in the 1980s and is expected to remain there till the end of this century. Wheat consumption has been officially promoted, and rising incomes and urbanization have helped in those efforts.

Wheat consumption per capita is projected to reach 105 kg in 1990 and 124 kg in 1995. Although the use of wheat for feed will remain limited, by 1988 China is expected to become the largest wheat consumer in the world. Total wheat consumption in China is expected to reach 113 million tonnes in 1990 and 141 million tonnes in 1995, and thereafter China will remain the largest wheat consumer in the world.

Trade — Between 1960 and 1980, average annual Chinese imports amounted to around 4.5 million tonnes. In 1980, China became a major player in the wheat market of the world by importing 13.8 million tonnes of wheat, and it repeated that performance for two consecutive years. In 1983, parallel to an increase in wheat production – from 68.4 million tonnes in 1981 to 81.4 million tonnes in 1983 – Chinese imports dropped to 9.6 million tonnes. Production kept rising, and China imported only 6.6 million tonnes in 1985. The results of the most likely scenario show, however, that the increase in production will be unable to keep up with the projected increase in consumption, and in order to meet the domestic demand, China will have to import increasing quantities of wheat in the near future. Assuming no physical and financial constraints, such as port and storage capacity or foreign-exchange shortages, China is expected to import 14.6 million tonnes of wheat in 1990 and 33.9 million tonnes in 1995 (see Table 3-10).

Table 3-10

Projected Wheat Production, Consumption, and Trade in China to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	85.8	97.9	107.3
Consumption	92.4	112.5	141.2
Trade[1]	6.6	14.6	33.9

1 Imports required to meet excess demand for wheat.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Soviet Union

Production — The Soviet Union is the largest country in the world. As such, it is not surprising that the total volume of Soviet agricultural output is exceeded only by that of the United States and China. The reason for this third rank is that the Soviet Union, unlike the United States and China, lacks the environmental conditions to produce large quantities of corn or rice. Wheat makes up 50 per cent of the U.S.S.R. crop production. Most of the agricultural regions in the country experience large annual swings in climatic conditions; as a result, there are also large annual swings in crop yields and hence in crop production. Soviet agricultural production is also hampered by government policies that result in excessively large and bureaucratic production units, a shortage of inputs, and transportation and storage bottlenecks.

Since the 1917 Revolution, the Soviet Union has been steadily expanding agricultural output and consolidating agricultural production units into state farms, although a large portion of labour-intensive products, like livestock, is still produced on private plots. One of the methods used to expand farm output, particularly wheat output, was to develop new farm lands in Kazakhistan. From 1954 to 1958, over 40 million hectares of new lands were developed in that area. As those new lands are in a semi-arid part of the Soviet Union, however, yields are much lower than in the higher-rainfall farming areas in the western part of the country – the Ukraine. As a result of these semi-arid conditions, a small deviation in annual precipitation can easily translate into a large deviation in total production. That, in turn, causes a significant deviation in total Soviet wheat production.

Because of the size of Soviet wheat purchases, several studies have been carried out in recent years in order to look at some of the constraints and potential that exist in the Soviet farm sector. Among them are those of Lydolph (1979), Wadekin (1982), Howe (1983), Young (1983), Johnson and Brooks (1983), and the OECD (1983). Some of the main findings of those studies are summarized as follows:

- the average countrywide fertilizer-application rates are about the same as in the United States, but the full value of the fertilizer is usually not reached because of wastage in storage and transport and because the present method of allocating fertilizer is generally not done on the basis of economic criteria;

- weed control is generally poorer than in countries like Canada because herbicides are often in short supply;

- the Soviets generally use wheat-seeding rates that are three to four times higher than those in Canada, in hopes that the growing crop will compete better with weeds;

- in recent years, particularly in Kazakhistan, more land has been fallowed, and yields on the remaining sown land has consequently improved;

- the area under irrigation is being expanded, but this is almost totally negated by increasing problems with salinity in existing irrigation areas;

- the area under EC-style intensive cereal management is expanding rapidly, although the results may not be nearly as impressive as in the European Community because of the inconsistent quality of inputs and management;

- effective mechanization remains low in spite of the fact that the Soviet Union is now the world's largest producer of tractors and harvesters (although machinery production is higher, a significant proportion of machinery cannot be used effectively because of the inconsistent quality of production and an inefficient method of distributing spare parts);

- relative to the area in crop production, there is a lack of infrastructure, especially of roads and storage buildings; and

- the bureaucratic and centrally planned nature of the Soviet grain economy has constrained the ability of local managers to make fast and/or flexible decisions at the local level and has often led to wastage and theft of both inputs and outputs.

Soviet wheat yields are presently only slightly below those of similar climatic analogues in North America; however, corn yields are only about half as high as those in North America. Soviet experts have expressed doubt that corn yields can be increased much more, because even in the best corn-growing area, heat and moisture conditions are not as favourable as they are in North America.

The Soviet Union has experienced very unstable production over the last 27 years, and the growth rate had been quite low. Wheat production rose from 50 million tonnes in 1965 to 101 million tonnes in 1966, dropped to 66 million tonnes in 1975, and reached a historically high 121 million tonnes in 1978; since then, it has been steadily declining. It produced only 78.1 million tonnes of wheat in 1985.

General Secretary Mikhail Gorbachev has indicated that improving agricultural productivity is a priority of the government. As a result, there are substantial investments being made to increase production, including the adoption of Integrated Cereal Management technology from Europe and the development of irrigation systems. Given the land and climate of the country, there appear to be few physical constraints to increasing production. In the most likely scenario, it is assumed that some gains will be made and that production will increase at the 1961-87 rate. In the high-production scenario, it is assumed that production will increase at 150 per cent of the past trend. In the low-production scenario, it is assumed that production will increase at only 50 per cent of the past trend despite the renewed efforts to increase production.

Consumption — Until 1984, the Soviet Union was the largest wheat consumer in the world; in recent years it has been second to China. The distinguishing feature of its wheat consumption is the large quantity that is used for animal feed. In the period 1981-86, the amount used for animal feed averaged 39 million tonnes, and total consumption – including the amount used for seed and waste – was 96 million tonnes.[18]

The reasons for the Soviet Union's heavy use of wheat for feed are the country's lack of success in growing feed grains and the availability of lower-quality wheat. Even though the Soviets import large quantities of feed grains, because of the inefficient inland transportation system, those grains are usually used in regions close to its Black Sea and Baltic ports, and wheat is readily available for feed in those parts of the country where feed demand is concentrated. Plans for 1990 targets are to double the maize output; however, that will be hard to achieve because of the short growing season.[19]

The Soviet Union's 1982 New Food Program set aims for the development of food and agriculture for the 1980s and targeted self-sufficiency in grains. The rise in income per capita will reduce the per-capita use of wheat for food from 202 kg in 1986 to 195 kg in 1990 (188 kg in the high-case scenario) and 189 kg in 1995 (175 kg in the high-case scenario). The per-capita use of wheat for feed, parallel to per-capita meat consumption, is expected to rise from the 128 kg in 1986 to 129 kg (130 kg in the high-case scenario) in 1990 and to 130 kg (132 kg in the high-case scenario) in 1995. In the most likely scenario, total wheat consumption in the Soviet Union is projected to rise from 92 million tonnes in 1985 to 102 million tonnes in 1990 and to 105 million tonnes in 1995.

Trade — Until 1971, the Soviet Union was an exporter of wheat – mainly to the Eastern European countries. In 1970, net grain exports amounted to 7 million tonnes; by the mid-1970s, however, it became a major grain importer, with net grain imports in 1985 peaking at 54.5 million tonnes, of which net wheat imports accounted for 26.9 million tonnes.[20] The reason for the turnaround was a shift in Soviet policy in 1970 from adjusting consumption to production to using international markets to make up domestic-production shortfalls. At the same time, meat consumption and production were encouraged. The rapid increase in livestock feeding and a desire to protect the livestock industry from erratic domestic grain production led to increasing grain imports. Besides these policy changes, the Soviets experienced bad wheat crops in the 1970/71 crop year, although consumption was maintained by using up stocks. A second crop failure in the 1972/73 crop year forced the Soviet Union to import 13.6 million tonnes, which represented 20 per cent of world imports. Between 1971/72 and 1972/73, the Soviet Union's net position changed by 16 million tonnes, whereas world trade increased by only 15 million tonnes;[21] thereafter, it became, and remained, a major wheat-importing country.

Given the consumption and production projections reported in Table 3-11, in the most likely and low-case scenarios, the Soviet Union will remain a net wheat importer over the projection period; however, imports will decline steadily. In the high-case scenario, the Soviet Union is expected to be a net wheat exporter after 1992.

Table 3-11

Projected Wheat Production, Consumption, and Trade in the Soviet Union to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	78.1	95.1	98.7
Consumption	91.6	101.9	104.8
Trade[1]	15.7	6.8	6.1

[1] Imports required to meet excess demand for wheat.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

India and Pakistan

Production — The favourable latitude of 8°N to 37°N, diverse landform, and variety of climates have enabled both India and Pakistan to grow a wide variety of crops. In addition, the percentage of arable land is higher than in most countries, and the percentage of irrigated land is among the highest in the world. Wheat production and consumption in that region has been growing rapidly, amounting to almost 56 million tonnes annually. Unlike many other wheat-producing regions, almost all of the wheat produced is used for human consumption.

Through the introduction and widespread adoption of high-yielding varieties over the last 20 years, wheat production has increased more than fourfold in India and Pakistan.

Because of the steadily rising populations, it is very likely that the governments of both India and Pakistan will continue to support increased agricultural output. Based on experience in the Punjab, many agricultural experts feel there is still much potential in India and Pakistan to increase the output of crops like wheat. Before this can happen, however, small landholdings will have to be consolidated into a more economic size; and lease arrangements will have to be improved, since at present many "landless labourers" are farming under lease arrangements that discourage any improvement in technology, and small and landless farmers often have little or no access to the inputs, infrastructure, and management necessary to adopt the Green Revolution technologies.

Removal of those types of constraints will obviously affect the political and social structure of rural areas; therefore, it is unlikely that the changes can be made quickly. Hence the production of wheat in that region is likely to continue to increase, but the rapid rate of growth experienced over the last two decades is not likely to be repeated unless significant rural reforms take place.

India and Pakistan have had remarkable success in increasing production, having experienced very rapid growth during the 1980s; however, most areas now use high-yield varieties, making future increases more difficult. In the most likely scenario, it is assumed that production will continue to grow at one-half the 1960-87 trend. In the high-production scenario, it is assumed that the increase in production has not hit any physical limits and that future improvements in yields and the more widespread adoption of HYVs could continue to increase yields at the previous rate. In the low-production scenario, it is assumed that the accumulating wheat stocks, combined with low export prices, will force India and Pakistan to curtail growth in production to one-quarter of the previous rate.

Consumption — India is the third largest wheat consumer in the world. Wheat consumption doubled over the last 15 years, having reached about 46 million tonnes in 1986. Wheat has become the major food staple in the north, but nationwide it follows rice. Large quantities of coarse grains are also used for food. In the last three crop years, wheat consumption has been below expectations and could not match the rapid growth in production because of the low purchasing power among consumers. Year-end wheat stocks in 1986 are estimated to have equaled 15.5 million tonnes,[22] which exceeds the country's permanent grain-storage capacity.

The Indian government has introduced measures to promote wheat consumption. "There have been programs to distribute grains at concessional prices and expanded food-for-work programs. Restrictions on the amounts ration card holders can obtain have also been lifted for the time being."[23] These programs, together with relaxed export restrictions, are expected to increase wheat consumption; however, any growth in consumption achieved through government subsidies to consumers is not likely to be sustained because of the high budgetary costs.

In the most likely scenario, with a population growth rate of 1.9 per cent per year and the current growth rate of 1.6 per cent in per-capita income, the per-capita consumption of wheat for food is expected to be 61.8 kg in 1990 and 67.2 in 1995, compared with 56.8 in 1985. In the high-case scenario, those figures are expected to be 72.81 kg in 1990 and 93.31 kg in 1995; in the low-case scenario, 65.75 in 1990 and 76.11 in 1995.

Table 3-12

Projected Wheat Production, Consumption, and Trade in India and Pakistan to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	55.8	64.5	69.2
Consumption	56.5	68.0	82.3
Trade[1]	1.5	3.5	13.1

1 Imports required to meet excess demand for wheat.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

The use of wheat for feed in India is negligible: total feed use in 1985 was less than 1 per cent of total wheat consumption.

In Pakistan, despite the positive impact of the Green Revolution on wheat and rice production, which has enabled many people to switch from eating maize to wheat, undernourishment and malnutrition continue to be major problems. As in India, the poor are entitled to subsidized rations of wheat flour; however, that costly subsidy is expected to be eliminated soon. Only a little wheat is used for animal feed, and as of 1985, the per-capita consumption of wheat as food was 134.5 kg. That figure is expected to vary between 146 kg and 156 kg by 1990, and between 156 kg and 180 kg by 1995, depending on the projected growth rates of GDP per capita.

Trade — If the current subsidies to consumers prevail in the future, wheat production in the region will lag behind consumption. Import requirements for the region are expected to rise to 3.5 million tonnes in 1990 and to 13.1 million tonnes in 1995.

Eastern Europe

Production — Individually, the countries of Eastern Europe are relatively small, but taken together

(Czechoslovakia, West Germany, Poland, Bulgaria, Hungary, Romania, and Yugoslavia), they represent over 130 million people, and they produce in excess of 100 million tonnes of wheat.

After the Second World War, in order to combat the shortages of food that they faced, the Eastern European countries embarked on a program of massive farm consolidation through the formation of co-operatives, collectives, and state farms. The exception was Poland, which to this day has a large number of small, private farms. During that time, agricultural policies in Eastern Europe stressed higher farm output and food self-sufficiency through more-efficient production, less reliance on price subsidies, and minimal food imports. Those are still the guiding principles of present-day farm policies in that region.

Unlike in Western Europe, the prices of agricultural products have been kept low in an effort to keep urban food prices low. East European governments felt that because the unit costs of production were significantly lower on their massive farms, the high food prices of Western Europe were not necessary to encourage additional farm production. Nevertheless, the Eastern European governments have subsidized some agricultural inputs and have made large investments in rural infrastructure and machinery.

Agricultural production, particularly cereal production, rose steadily throughout the 1950s and early 1960s. Between 1965 and 1975, the rate of growth in cereal output increased dramatically as the ICM technologies from Western Europe were introduced and as more specialization of farms was allowed. In some instances, the rapid increase in fertilizer use and in mechanization may not have been cost-effective, but total output increased. That was very important to most countries of that region because not only did it reduce the need for hard currency for agricultural imports; it also allowed some countries – such as Bulgaria, Hungary, Poland, and Romania – to sell agricultural surpluses to the West for hard currency.

After that period of rapid growth, yields in the most favoured agro-climatic regions of Eastern Europe were above the average Western European yields. Since 1975, however, the growth in agricultural production has slowed down considerably. Although farm production has greatly increased, it is still not sufficient to satisfy completely the rapidly rising demands of consumers, in terms of assortment and quality, in such areas as animal products or fruits and vegetables.

In the future, Eastern European governments will likely continue to emphasize food self-sufficiency as much as possible. It is also possible, however, that because of the perceived success of contemporary Eastern European agriculture and the relative backwardness of the manufacturing and service sectors, governments may choose to invest an increasing amount in the manufacturing and service sectors, at the expense of agricultural investments. Thus it is likely that the growth rate of cereal output will, at most, match that of the last decade. It could rise, however, if governments would allow more private initiative and flexibility in farm production. Such reforms have already dramatically raised productivity growth in planned economies like those of Hungary and China.

The most likely scenario is that future production growth will be at the 1961-86 trend rate. In the low-production scenario, it is assumed that production will stabilize at the 1986 level, with no growth.

Consumption — The Eastern European countries were badly affected by fuel and foreign-currency shortages, and by international debt problems in the early 1980s. Agricultural output stagnated, and food shortages were experienced in the region. Meat was not readily available, and consumers had to rely more on grains. As in the Soviet Union, the proportion of wheat used as feed is quite high in the Eastern European countries because domestic wheat is not of milling quality.

The rate of population growth in the region is quite low – between 0.2 and 0.6 per cent[24] – and the per-capita consumption of wheat as food has very likely passed its peak in most of the Eastern European countries. In 1986, the per-capita use of wheat as food averaged 184 kg in the region.[25] As income per capita grows, some decline in the per-capita use of wheat as food is to be expected – 169 kg in 1990 and 166 kg in 1995.

As production and storage techniques improve, the proportion of domestic wheat crops that is not usable for milling will slowly decline, and that will reduce the non-food use of wheat. As a result, total wheat consumption in the region may be lower than the levels reported in Table 3-9.

Trade — Eastern Europe has historically been a small net wheat importer. Until the early 1970s, the import requirements of Eastern Europe were largely met by the Soviet Union; however, since then, the latter has itself become a net wheat importer, and Eastern Europe has had to rely on the West for its grain imports. Eastern Europe has also transferred ICM technologies from Western Europe; thus it experienced some success in increasing production in the early 1980s. Thereafter, the volume of net wheat imports

Table 3-13

Projected Wheat Production, Consumption, and Trade in Eastern Europe to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected	
		1990	1995
	(Millions of tonnes)		
Production	37.1	43.9	49.4
Consumption	38.4	38.0	38.5
Trade[1]	–1.3	5.9	10.9

[1] Net imports (–) and exports (+), based on excess demand or excess supply.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

started to decline, and in 1984/85 the region actually moved to a net-exporter position. Given the most likely production and consumption scenario, Eastern Europe is projected to be a net wheat exporter in the near future, with the volume of excess supply estimated to be 5.9 million tonnes in 1990 and 10.9 million tonnes in 1995 (see Table 3-13).

Australia

Production — As in Canada, wheat production in Australia is low relative to total world production, but because the population is small, over 75 per cent of the Australian wheat crop can be exported. Unlike in Canada, however, the majority of Australia's wheat crop consists of medium-hard white wheats that are exported mainly to countries of the Middle East and Asia (including the Soviet Union).

In addition, the majority of Australia's wheat is grown by farmers who also raise sheep. The sheep are generally considered complementary to wheat production rather than in competition with it. That is different from other cereal-growing areas of the world (with the possible exception of Argentina), where the grain farmer is almost exclusively involved in grain production. That, in turn, leads to increased flexibility between livestock and wheat, and changes in the cost of production or technology can cause significant shifts in the allocation of land between sheep and wheat production.

Another unusual trait of the Australian wheat sector is that since 1970, wheat yields have remained almost stationary. That can be attributed to at least four factors: 1) higher-yielding wheat varieties, based on semi-dwarf Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) varieties, have not been very successful; 2) the area sown to wheat during the decade to 1980 exceeded that of the previous decade by 14 per cent, but because increasingly marginal land was being planted, the overall average wheat yield fell; 3) as the use of pasture legume rotations was reduced, soil fertility dropped, and the incidence of fungal diseases and eelworms increased; and 4) the fourfold increase in the Australian price of superphosphate led to a 34-per-cent reduction in its use on wheat crops (Australian wheat lands are particularly deficit in phosphate) and thus to a reduction in yields.

If real wheat prices were to rise and/or if wheat varieties that require a shorter growing season – or legumes that are adaptable to dryer conditions – were developed, there would be a very good chance of developing an additional 10 million hectares of wheat land. In the absence of such developments, it is more likely that wheat areas and yields will remain relatively constant, or even decline, if wheat prices continue to fall relative to wool prices.

The future of the Australian wheat economy depends, much as does Canada's, on developments beyond its borders. Because of the importance of wheat as a major farm product and export item, the Australian government will, no doubt, continue to support production as much as possible. As in Canada, however, the Australian wheat sector depends on exports, and that limits government action to counter moves such as export subsidies on the part of competing wheat exporters like the European Community and the United States. Traditional government support for such things as wheat research, centralized selling, and market development will no doubt continue, however. In short, the volume of wheat production in Australia will likely stabilize, or even fall, unless wheat prices in the world rise significantly.

In the most likely scenario, production will fall by 1.5 million tonnes to 15.4 million tonnes and will remain at that level. There is little prospect of any increase in government subsidies to support production above that level; thus this forecast also reflects the high-production scenario. Australia has, in the past, increased forage acres for sheep because of price movements. In 1970, the wheat area fell 24 per cent below trend. In the low-production scenario, it is assumed that a similar reduction will lower production to 13 million tonnes per year.

Consumption — In Australia, wheat consumption follows an erratic pattern. The use of wheat for food has been

Table 3-14

Projected Wheat Production, Consumption, and Trade in Australia to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	16.2	15.4	15.4
Consumption	2.7	3.1	3.3
Trade[1]	16.0	12.3	12.1

1 The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

very stable, but it is expected to decline from the 133 kg per capita in 1985 to 130 kg in 1990 and 127 kg in 1995, as per-capita income grows. The variability in total wheat consumption stems from the variability in the use of wheat for feed. The most likely scenario shows a slight increase in the volume of wheat utilized for animal feed; on a per-capita basis, wheat consumed as feed is expected to rise from the 56 kg in 1985 to 57.7 kg in 1990 and to 60 kg in 1995. Total wheat consumption is also projected to increase from the 2.7 million tonnes in 1985 to 3.1 million tonnes in 1990 and to 3.3 million tonnes in 1995.

Trade — Australia, until 1980, was the third largest wheat exporter in the world, with a market share that varied between 8.7 and 17.6 per cent; after 1980, it lost its position to the European Community. Australia exports approximately 75 per cent of its annual wheat production. In the future, the country will maintain its position as the world's fourth largest wheat exporter; however, Australia's exports and market share are expected to decline. Estimates by the U.S. Department of Agriculture showed that the volume of exports would decline from the 16 million tonnes in 1985 to 13 million tonnes in 1987 and that the market share would decline from the 16.7 per cent in 1985 to 12 per cent in 1987.[26] These figures were very close to our projections. Our production and consumption projections show that the excess supply in Australia will go down to 12.3 million tonnes in 1990 and to 12.1 million tonnes by 1995.

Argentina

Production — The grain sector in Argentina has grown dramatically over the past three decades, and Argentina is now the world's second largest exporter of coarse grains, the third largest exporter of oilseeds and oilseed products, and the fifth largest exporter of wheat. Unlike other major grain exporters, however, Argentina is extremely dependent upon agricultural production; 25 per cent of government revenue and gross domestic product comes from agriculture, and agricultural exports account for 80 per cent of all foreign-exchange earnings. Despite that heavy dependency on agriculture, the government cannot afford to support the agricultural sector even to the extent that a country like Australia does.

Fortunately, most of Argentina's grain crops are grown on a vast, fertile, and relatively moist plain called the Pampas. Traditionally on the Pampas, crops like wheat were rotated with legume pastures, with the legume pastures supporting a large herd of cattle. Because of that rotation, little or no fertilizer, or herbicides, were needed for grain crops, although that is gradually changing because the grain area is expanding much faster than pasture land. In addition, most farms on the Pampas are very large and mechanized. These factors have all enabled Argentina to be one of the lowest-cost wheat producers in the world. The extensive production of cattle and the wide range of crops that can be grown in Argentina have also provided farmers with more income stability than is prevalent in countries like Canada, where production choices are much more limited. Traditionally, the government of Argentina also created some measure of farm-price stability through a policy of export taxes on agricultural products. When export prices were high, export taxes were raised; conversely, when prices dropped, so did the taxes.[27] These taxes were applied in such a way as to encourage as much agricultural processing as possible within Argentina.

Although the Argentina grain sector has many natural advantages, its development has been hampered by several factors. Those factors include inadequate storage and transportation facilities, and taxes on agricultural exports and inputs, as well as political instability, rampant inflation, and tremendous fluctuations in exchange and interest rates.

As a consequence, Argentina's agricultural resources are underutilized, its grain marketing infrastructure is grossly undercapitalized, and farm prices are among the lowest in the world. The grain output from Argentina could greatly expand if real grain prices rose and if the government could establish a sense of stability in the economy.

Like many other grain-exporting nations, the future of the wheat sector in Argentina depends much more on changes in government policies, both outside and inside Argentina, than it does on physical or technological changes. Domestically, the government will, no doubt, continue to press for increasing the exports of processed agricultural products and to switch from export taxes to land-based taxes. Both of these measures will cost the government very little and will not represent a major break from past and recent policies. Both will encourage increased production of higher-valued crops like soybeans and sunflowers, at the expense of crops like wheat. If the government can bring a sense of stability back to the economy, however, long-term investments in the grain sector would be further encouraged. This would tend to increase wheat output in the developing, dryer fringe areas of the Pampas, where conditions are such that wheat has a comparative advantage over most other crops. Because of the present low world prices for grains and the still-unsettled political situation in Argentina, however, wheat output from Argentina will likely drop, or, at most, remain at its present level in the near future.

In Argentina, producers will have to absorb the cost of the severe decline in world market prices, with very little prospect of government support. In the most likely scenario, some of the effects of the price decline were assumed to be offset by a 10-per-cent reduction in the export tax, which was announced in January 1987, and Argentina will experience a drop in production of 1 million tonnes, with no prospect of growth; production will stabilize at around 9 million tonnes per year. In the high-production scenario, the government could remove the current 5-per-cent tax; however, that would have virtually no effect on production. In the low-production scenario, Argentina may shift from wheat to more beef production. In 1977, the wheat area in Argentina dropped 27 per cent below trend. A drop of that magnitude is used in the low-production scenario, which translates into a production level of around 7 million tonnes.

Table 3-15

Projected Wheat Production, Consumption, and Trade in Argentina to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	8.5	9.4	9.4
Consumption	4.4	4.7	5.1
Trade[1]	4.3	4.7	4.3

[1] The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Consumption — In Argentina, very little wheat is used for animal feed, and food use is quite stable. Currently, per-capita wheat consumption is 142 kg, and it is projected to remain constant. Therefore, total wheat consumption will increase at the rate of population growth.

Trade — Argentina is the fifth largest wheat exporter in the world and is projected to lose that position to Eastern Europe by the end of this decade. If Argentina manages to keep production stable at around 9 million tonnes, however, it will continue to export almost one-half of its annual production.

Rest of the World

The countries and the regions studied in the foregoing sections of this chapter produced 89 per cent of the total wheat output of the world in 1985. All other countries are grouped under the heading "Rest of World" (ROW). Production in the ROW, in the most-likely scenario, was assumed to follow the 1961-86 trend. Consumption projections are made for a large group of countries which, on average, account for 85 per cent of total world consumption. Wheat consumption was assumed to grow at the same rate in the ROW, which accounts for the remaining 15 per cent of world consumption; hence wheat-consumption projections were obtained for the world.

The import requirements of the ROW were computed as the difference between the production and the consumption projections. The ROW has historically been a net wheat importer and, in the aggregate, is projected to remain so. Production, consumption, and trade projections for the ROW are reported in Table 3-16. These net import figures, because of aggregation, somewhat underestimate the total volume of imports by that group of countries. Statistics from the U.S. Department of Agriculture show, however, that in addition to the countries and regions assessed in this report, there are three other exporters – namely, "other Western European countries"; Turkey; and "other countries." During the last five years, the "other Western European countries" have exported approximately 1.4 million tonnes and imported 0.8 million tonnes of wheat per year, and their net exports have been around 0.6 million tonnes. Turkey has had an annual export average of 0.3 million tonnes and has imported 0.7 million tonnes, making it a net importer. The exports of "other countries" averaged only 1.3 million

Table 3-16

Projected Wheat Production, Consumption, and Trade in the Rest of the World to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	56.6	61.1	63.2
Consumption	108.0	120.9	136.9
Trade[1]	51.4	59.8	73.7

[1] Imports required to meet excess demand.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

tonnes. Therefore, if there is a downward bias in the projected imports of the ROW, it should be no more than 1 to 2 million tonnes per year.

Wheat: Projections to 1995

An aggregation of the projections presented earlier in this chapter yields forecasts of the world's wheat production, consumption, trade, and stocks. The different growth rates for consumption and production experienced over the last 25 years have caused variability in the total wheat stocks and in the stock/use ratio. During that period, the stock/use ratio varied between 17.3 per cent and 37.5 per cent, creating instability in wheat prices. Since the beginning of the 1980s, wheat production in the world has been consistently higher than wheat consumption; thus world stocks have built up. The stock/use ratio rose from 18.3 per cent in 1980/81 to 28.1 per cent in 1985/86, and prices kept falling.

Our most likely scenario assumes that in response to accumulated world stocks and depressed prices, the major wheat-growing countries will try to stabilize production at levels below trend. Even with that assumption, the wheat consumption of the world will catch up with the trend of world production by 1990 (see Table 3-17). Until the stock/use ratio levels at around 20 per cent, producers will not respond to consumption. By 1993, the stock/use ratio will go down to 21 per cent. At that point, the major wheat producers may either respond to the decline in the stock/use ratio and increase their production volume up to the levels of the high-production scenario, or keep production at current levels and let prices rise. If they move up to the high-production scenario, the wheat production of the world will reach 621 million tonnes by 1995, and the stock/use ratio will rise, leaving the prices at current levels. This, of course, is not a viable alternative, but neither is letting the stock/use ratio go down as low as 10 per cent (see Table 3-17). It is therefore realistic to say that wheat production in the world will be somewhere between 572 and 621 million tonnes.

The year 1990 is projected to be a turning point for wheat trade in the world as well. Until 1990, the excess supply of wheat – i.e., the volume that exporters will have over and above their domestic-consumption needs and current stocks – will exceed total import demand. Therefore, the volume of trade will be determined by the volume of import demand. After 1990, once world consumption catches up with world production, import demand will exceed the export supply. The world stocks of wheat will still be high enough, however, to make up the difference between import demand and export supply, and the volume of world trade will be determined by import demand. Under this scenario, the volume of world trade could be as high as 127 million tonnes by 1995, with real prices being considerably higher than the U.S. loan rate. If this price rise shifts world production up to the high-production scenario, there will be a significant decline in total import demand, and the volume of world trade will be only 94 million tonnes by 1995, with the price of wheat leveling out at its current rate.

Table 3-17

Projected Worldwide Wheat Production, Consumption, and Trade, and Year-End Stocks to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	500.0	543.0	572.0
Consumption	487.6	542.4	606.5
Trade[1]	84.6	84.7	126.8
Year-end stocks	136.9	153.0	63.6
	(Per cent)		
Stocks as a proportion of utilization	28.1	28.0	10.0

[1] Exports required to meet import demand.

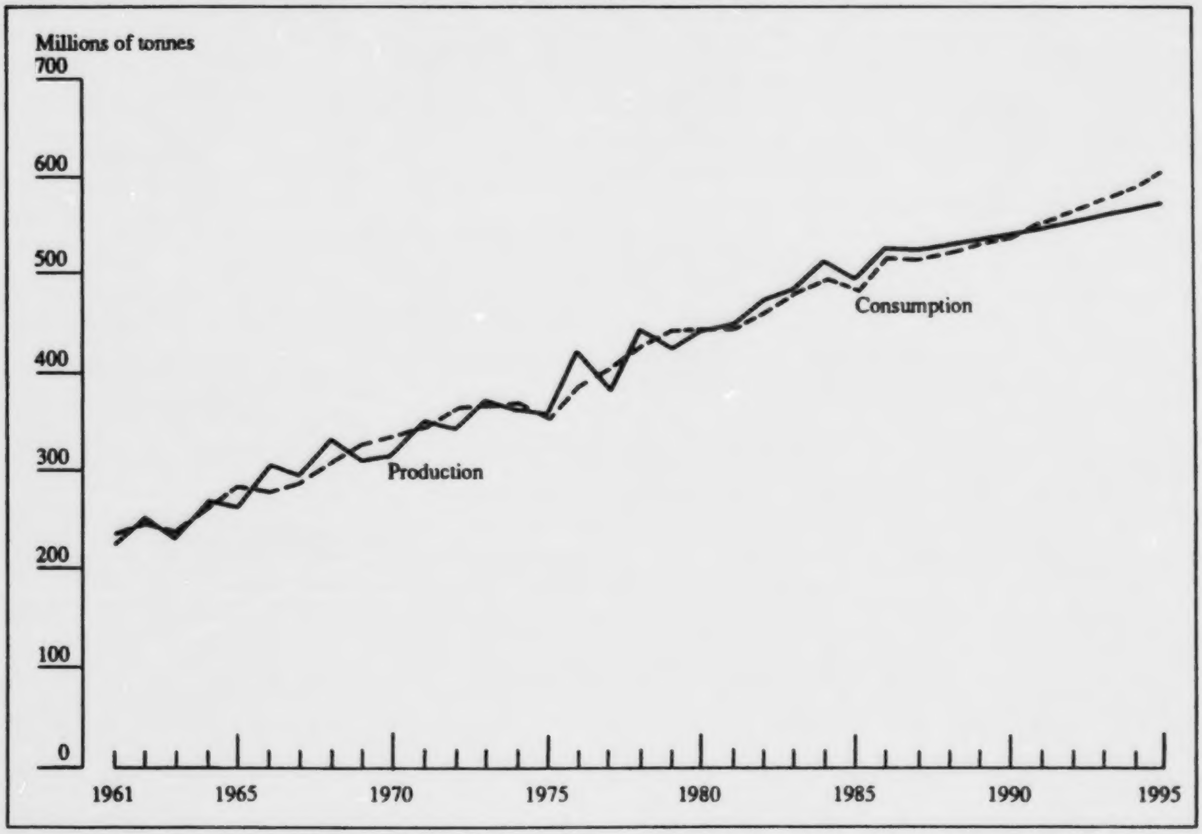
SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

An alternative scenario, as mentioned earlier in this chapter, is the removal of government programs that support production in the major-producer countries. In that case, production is expected to decrease in Canada, in the EC-12, and in Australia. A slight rise in production in Argentina and a significant increase in the United States would also follow. The overall effect of this policy adjustment would be an increase in world production and stocks. The stock/use ratio would remain above 20 per cent, and prices would be aligned with the U.S. loan rate. Since world trade would still be determined by the demand side, there would be no change in trade volume reported in Table 3-3; yet the market share of each of these countries assessed would adjust to new production levels.

Past developments and future projections of the world's wheat production, consumption, trade, and stocks are shown in Charts 3-1 and 3-2.

Chart 3-1

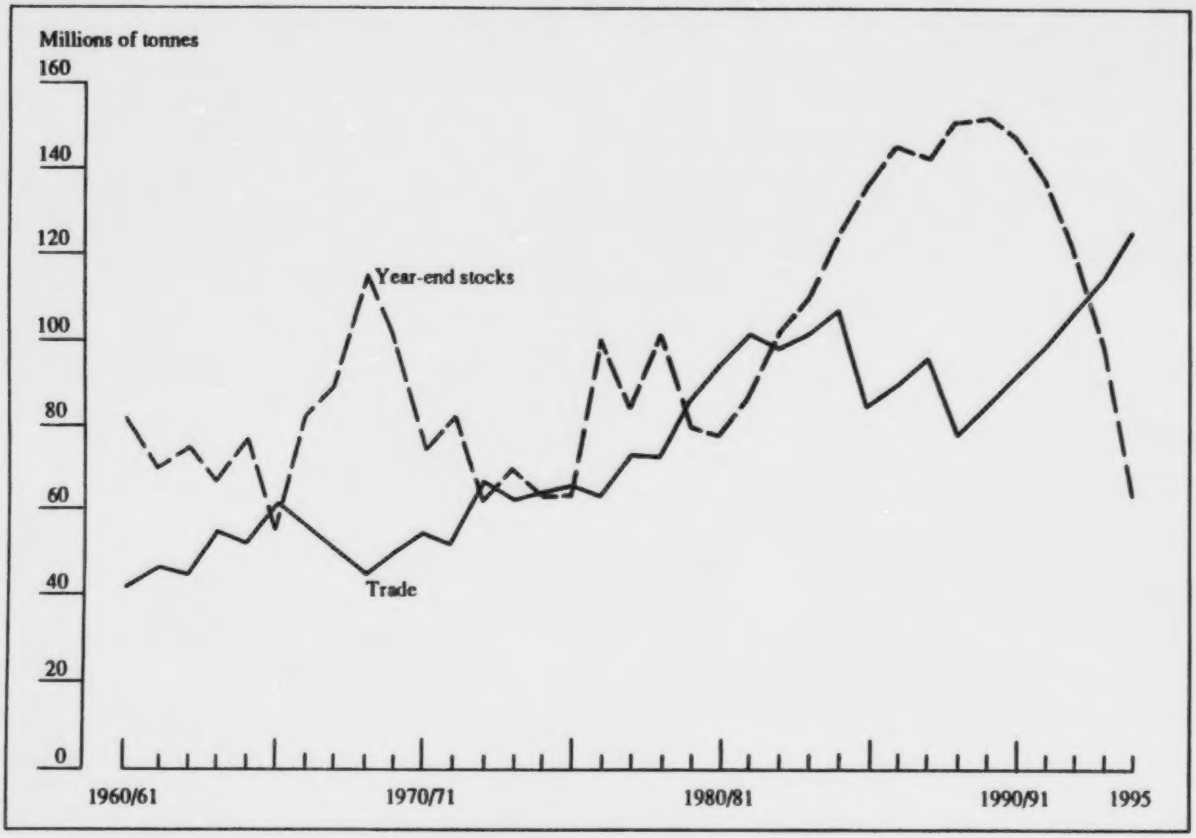
Actual and Projected Worldwide Production and Consumption of Wheat, 1961-95



SOURCE Estimates by the authors based on data for 1961-86 from U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987.

Chart 3-2

Actual and Projected Worldwide Trade in Wheat, and Year-End Stocks, 1961-95



SOURCE Estimates by the authors based on data for 1961-86 from U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987.

4 The Coarse-Grain Economy of the World

The term "coarse grains" is used to describe those grains which are used principally for livestock feed. The most abundant coarse grains are corn, barley, and sorghum, which make up 56 per cent, 20 per cent, and 8 per cent of total coarse-grain production, respectively. Other coarse grains include rye, oats, triticale, millet, and mixed grains. Wheat, although not a coarse grain, is a substitute for corn in times of excess wheat supply.

Coarse-grain production in the world has increased significantly, having nearly doubled over the past 25 years. This growth in production has come about despite the secular decline in the price; thus the increase in production cannot be described as simply movement along a single supply curve. Instead, the increase in production is the locus of equilibrium points on supply curves that have shifted to the right over time. As with wheat production, the mechanism by which the supply curve has shifted can be described as a function of investment and technical change, both of which are irreversible. This makes production adjustments to a decline in price much smaller than the response to a price increase. In addition, governments protect their producers from a severe price decline through a number of policy mechanisms that tend to isolate producer prices from the world export price. This exacerbates the inelastic nature of the supply curve.

Coarse-grain production occurs in virtually all countries of the world; however, the vast majority of production occurs in relatively few regions. The United States is, by far, the largest producer of coarse grains, with 30 per cent of world production. Other major producers include China, the Soviet Union, the European Community, Eastern Europe, Canada, and Brazil.

Coarse grains, like wheat, are utilized as both human food and animal feed. Over the last two-and-a-half decades, coarse-grain consumption in the world has almost doubled. In 1985, 771 million tonnes of coarse grains were consumed, of which 509 million tonnes were utilized for feed. The increase in demand for coarse grains basically comes from the increase in demand for meat and meat products. Over time, the demand for these products increases mostly in response to income and population growth. Therefore, forecasting coarse-grain consumption to 1995 requires an analysis of the equilibrium points on demand curves that have shifted to the right over time. The demand for coarse grains in this report was treated as derived demand (except in the case of China), and future consumption was projected by using the income elasticity of demand for red meat (see Appendix C).

Parallel to the increases in production and consumption, world trade in coarse grains has also more than tripled; in fact, it rose from 30 million tonnes in 1961 to 101 million tonnes in 1984. In 1985, however, the volume of world trade dropped to its 1976 level of 83.4 million tonnes, causing the total world stocks of coarse grain to rise to historically high levels.[1] Stocks as a proportion of total utilization amounted to 24 per cent – the highest rate during the period in question – and that further depressed the already-low grain prices.

Country Assessments: 1960-95

The ultimate goal of this chapter is to project the direction of change in coarse-grain prices to 1995. This requires a projection of future coarse-grain stocks. The year-end stocks in this study were computed as a residual by using the production and consumption projections.

In order to develop a forecast of future production, it is essential to examine the coarse-grain sectors of major-producer regions and countries, and to analyze the possible effects of government policies on production. To address the uncertainty of forecasting government policy, three production scenarios – low, high, and the most likely – were examined for each of the major-producer countries. In the most likely scenario, it was assumed that the current policies in place in all major-producer and consumer countries, with the exception of China, would be followed until the stock/use ratio fell below the critical level of 16 per cent. Once that level of stocks is achieved, coarse-grain prices will start to rise. At that point, the major-producer countries are assumed to change their policies and to move up to the high-production scenarios in response to rising prices.

Three parallel scenarios were developed for coarse-grain consumption as well (see Appendix C). The major-producer and consumer countries are studied separately, and the others are treated as an aggregate group – the rest of the world. In the most likely scenario, the 1980-85 growth rates in per-capita income were assumed to prevail in the future in all countries and regions, but China was kept on the low-consumption scenario. That point will be discussed further in the last section of this chapter.

Excess demand (i.e., potential import demand) and excess supply (i.e., potential export supply), assuming that the stocks held are constant for each region and country, were computed as the difference between the projected production and consumption levels.

Canada

Production — The growth of coarse-grain production in Canada has been the fastest of any country in the world, having increased from 7.7 million tonnes in 1961 to 26.1 million tonnes in 1986. That increase in production came about because of a substantial increase in barley production and the development of corn production in eastern Canada. The severe decline in export prices has been somewhat tempered with production stability and subsidy payments to producers. In Canada, the support mechanisms for wheat and coarse grains are very similar; therefore, there is little reason to expect a significant shift in production between coarse grains and other crops. That being the case, one would expect, in response to depressed international markets, a similar decline in both wheat and coarse-grain production in Canada. Using a cost-of-production analysis, it was estimated that wheat production would decline by 10 per cent, with little prospect of growth.[2] In the most likely scenario, coarse-grain production was also assumed to decline by 10 per cent and to stay at that level until prices start rising. In the low-production scenario, the government could further uncouple income support from production, leading to a 15-per-cent reduction in production. In the high-production scenario, which is expected to occur after 1992, increased government subsidies would maintain coarse-grain production at the 1986 level.

Consumption — In Canada, 90 per cent of coarse grains are utilized as animal feed; therefore, the demand for coarse grains is basically derived from the demand for meat. In 1985, red meat consumption per capita in Canada was 67 kg, and it is not expected to change significantly in the near future. Total coarse-grain consumption is expected to increase slightly in response to population growth.

Trade — Canada exports barley and barley products, rye, oats and oat products, and corn. In terms of the volume of exports, barley accounts for 60 to 90 per cent of the total exports of coarse grains in any given year. Corn is a relatively new crop and has been exported in significant quantities since 1975.

Table 4-1

Projected Coarse-Grain Production, Consumption, and Trade in Canada to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected	
		1990	1995
	(Millions of tonnes)		
Production	25.0	23.5	26.1
Consumption	19.2	20.5	22.0
Trade[1]	4.6	3.0	4.1

[1] The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Canadian coarse-grain exports and the market share have risen significantly since the early 1970s. In the decade of the 1960s, average annual exports amounted to 1.2 million tonnes, or 3.5 per cent of world trade. In 1970, Canada's market share increased to 9 per cent and averaged out at 5.4 per cent, or 4.3 million tonnes per year, during the 1970s. In 1986/87, Canada exported 6.5 million tonnes of coarse grains – 7.8 per cent of world trade.[3]

In response to an expected reduction in production, Canadian export supply is projected to decline until 1992. After that, parallel to the projected price rise, production and export supply will start rising. It is projected that in 1995 Canada will export 4.1 million tonnes of coarse grains.

United States

Production — In addition to being the largest producer of coarse grains, the United States is, by far, the largest exporter, and it holds the most of the world stocks. As of 1985, it produced 33 per cent of the world's coarse grains, exported 38 per cent of the total volume traded internationally, and held 68 per cent of total world stocks.[4] In the past, U.S. government policy determined, to a large extent, how much coarse grain would be produced and at what price it would be sold. As in the case of wheat, the United States supports the price (via the Nine-Month Loan Program and the Farmer-Owned Reserve) by offering a non-recourse loan to farmers at the loan rate, to encourage them to store grain when prices are near or below that loan rate. By the end of the 1987/88 crop year, it is estimated that the United States will hold 142 million tonnes of coarse-grain stocks,[5] the vast majority of which will be government-controlled stocks. This massive stock-holding program has provided a floor price for the world's coarse-grain market. Since 1961, the U.S. average farm price for corn – 24 times out of 27 – has deviated from the loan rate by only $10/tonne. On three occasions, the prices have been significantly above the loan rate: in the 1973-75 period, in 1979/80, and in 1983.

In the 1985 *Food Security Act*, the U.S. government lowered the loan rate for coarse grains by nearly 30 per cent in an attempt to expand U.S. exports by discouraging non-U.S. production and encouraging consumption. It did not succeed, however, in lowering U.S. stocks in 1986/87; in fact, the U.S. stocks were expected to increase by over 30 million tonnes during the first year of the new Act.[6] In response to the growing stocks, the U.S. government announced a large Acreage Reduction Program to reduce the acreage seeded in the 1987/88 crop year. That program is projected to reduce U.S. production to 218 million tonnes.[7] Given the very large stocks and large deficiency payments, the U.S. government is unlikely to allow increases in production within the next five years. It is therefore most likely that coarse-grain production will continue at a level of 218 million tonnes until the world's stock situation and prices improve significantly, which is expected to happen by 1992. After 1992, the United States is expected to shift to the high-production scenario, and by 1995 the production of coarse grains will amount to around 238 million tonnes.

In the high-production scenario, it is assumed that the government will continue into the future with an exact duplicate of the 1987/88 program and will be unable to stop some of the production increases that will occur because of higher yields. In this scenario, production will increase at the rate of one-half of the 1961/86 trend after 1987/88.

In the low-production scenario, it is assumed that the U.S. government may curtail production by a further 10 per cent in an attempt to control program costs. In this scenario, production falls to 198 million tonnes in 1988 and beyond.

Consumption — Red meat consumption per capita in the United States has been stabilized at around 77 kg, and no significant increase is expected because of income growth. The major source of a shift in demand for coarse grains will be population growth, which is quite low; therefore, no major shift in domestic consumption is expected to occur.

Table 4-2

Projected Coarse-Grain Production, Consumption, and Trade in the United States to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	274.9	218.1	237.9
Consumption	170.3	182.4	190.1
Trade[1]		35.7	47.9
Exports	36.6		
Stocks	58.0		

1 The excess supply available for export or for stock.

SOURCE Estimates by the authors, based on 1985 figures from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Trade — The U.S. market share of trade in coarse grains increased steadily between 1961 and 1975 – from 31 per cent (9.3 million tonnes) in 1961 to 66 per cent (71 million tonnes) in 1975 – and leveled out at around 65 per cent until 1980. After 1980, the U.S. market share started to decline and fell to 44 per cent (36.6 million tonnes) in 1985, causing the U.S. beginning stocks in 1984 to rise from 40 million tonnes to 127 million tonnes in 1986.[8]

The level of U.S. stocks and the market share depend upon U.S. policies. If the United States follows its current policies, the world's grain stocks will remain high until 1992 (in this case, the proportions of excess supply that will be exported or placed in stocks cannot be predicted). After 1992, world stocks will be low enough to allow the exporting countries to export their excess supply (in this case, U.S. exports will amount to 48 million tonnes in 1995).

European Community[9]

Production — The coarse-grain production of the EC-12 has more than doubled since 1961, having risen from 35.2 million tonnes in 1961 to 81.4 million tonnes in 1985. Given the increasing cost of the Common Agricultural Policy, it is unlikely that this growth will continue. The most likely scenario is that the European Community will implement policies that will limit future growth in production to one-half of the 1961-86 trend. In the high-production scenario, EC production could continue to grow at trend if there was an increase in the incentive to grow coarse grains at the expense of wheat. In the low-production scenario, the

European Community could impose production controls that would limit production to the 1986 level, with no future growth.

Consumption — Meat consumption per capita in the European Community has leveled out, and no significant increase is expected. Because of the stabilized meat consumption and low population growth rates in the member countries, coarse-grain consumption is not expected to change significantly in the near future. A change in the CAP, however, could result in a change in these projections. The CAP, by imposing high tariff walls, restricts imports of feed grains, and wheat and non-cereal feeds are used heavily in some member countries; therefore, changes in the CAP might cause larger amounts of coarse grains to be utilized for animal feed.

Trade — Until 1985, the European Community was a net importer of coarse grains, but its net imports declined steadily from 29.3 million tonnes in 1976 to 1.8 million tonnes in 1984.[10] The reasons for that development are twofold: first, producer subsidies encouraged production; and, second, the tariffs imposed by the CAP discouraged consumption, while low-quality wheat and non-cereal feed were substituted for coarse grains. As a result, the European Community became a net exporter of coarse grains in 1985, with net exports amounting to 1.4 million tonnes. The European Community is expected to maintain its position as a small net exporter until 1992. After 1992, in response to the falling stock/use ratio and projected price rise, the European Community will start producing and exporting more. Assuming that there will be no significant change in the feeding pattern, by 1995 EC exports could be as high as 11 million tonnes. If the CAP is changed, however, domestic consumption could be higher, and exports lower, than these projected levels.

Table 4-3

Projected Coarse-Grain Production, Consumption, and Trade in the European Community to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	88.3	84.7	96.3
Consumption	82.5	83.6	85.8
Trade[1]	1.4	1.1	10.5

1 The excess supply available for export.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

China

Production — China increased its production of coarse grains from 56.5 million tonnes in 1961 to over 90 million tonnes in 1986. Since the agricultural reforms of the late 1970s, the area of coarse grains has decreased by 17 per cent, and yields have increased by 25 per cent.[11] The allocation of land among different crops is basically determined by political forces, and it is beyond the scope of this report to predict shifts in policy; therefore, the land area planted to coarse grains was assumed to remain constant in the near future. It is very likely, however, that there will be an increase in research on high-yielding varieties of coarse grains, which has been neglected in the past. The production forecasts assume that China will be able to increase coarse-grain yields as much as it did rice yields. This set of projections represents the most likely production scenario for China. In the low-production scenario, it was assumed that there would be no change either in yields or in area planted and that production would stagnate around its 1986 level – 86 to 87 million tonnes – which is well below the projected consumption levels.

Consumption — China is a rapidly growing country, with the growth rate in GDP per capita projected to be well above 4 per cent per annum in the high case and 2.5 per cent in the low case. In the most likely scenario, considering China's capacity to produce and import, low growth rates were assumed to prevail in the future. The consumption of coarse grains per capita is projected to rise from the 73 kg in 1985 to 99 kg in 1995. Food consumption of coarse grains is assumed to remain at its 1986 level of 38 kg per capita. The reason for this assumption is the growth in per-capita income, which causes a shift in consumption from inferior grains to wheat. The amount utilized as feed was projected to increase from the 38 kg per capita in 1985 to 61 kg per capita in 1995. The total volume of coarse grains consumed as feed, parallel to the increased demand for meat and the population growth, is expected to increase from the 40 million tonnes in 1985 to 72 million tonnes in 1995. If the current growth rates (4.5 per cent) prevail, however, or if high growth rates (4.8 per cent) are achieved, meat consumption per capita and total coarse-grain consumption are projected to more than double the 1985 levels.

Trade — Until the mid-1980s, China was a small net importer of coarse grains; then it became a small net

Table 4-4

Projected Coarse-Grain Production, Consumption, and Trade in China to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	82.3	98.8	115.9
Consumption	75.8	95.2	116.4
Trade[1]	6.6	3.6	–0.5

1 Net imports (–) and exports (+), based on excess demand or excess supply.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

exporter. In the most likely scenario, China is expected to remain basically self-sufficient in coarse grains and to keep exporting small quantities until 1995. If the current or high growth rates are attained, however, Chinese consumption is expected to exceed the most likely production levels.

The import demand for coarse grains could then reach 5 or 6 million tonnes by 1990 and 29 to 34 million tonnes by 1995. These figures, of course, reflect the potential that could be realized in the absence of certain constraints, such as foreign-exchange shortages, and port and storage capacity. Also, these quantities need not be interpreted as the volume of coarse grains to be imported; rather, they reflect the feed equivalent of the import demand for meat in the future. If China chooses to import meat rather than expand its livestock industry, its import demand for coarse grains will be much smaller; however, the increased meat imports would have almost an equivalent impact on the world consumption and stocks of coarse grains. The sensitivity of world trade and stocks to various levels of Chinese consumption will be discussed in the final section of this chapter.

Soviet Union

Production — The climate of the Soviet Union is somewhat unsuited to corn production, lacking a large, moist, warm area with a long growing season. For that reason, the Soviet Union has relied on other coarse grains, principally barley, rye, and oats, as well as wheat, to meet its domestic feed requirements. Under General Secretary Gorbachev's leadership, the Soviet Union is committed to increasing agricultural output. The plans are to increase agricultural investment by a factor of 2.6 over the next five years.[12] As past performance shows, however, the new investment will achieve only limited success until the structure and the organization of the agricultural sector is reformed. In the most likely scenario, with the effect of the increase in investment, the Soviets were assumed to maintain the past growth rates in coarse-grain production. In the high-production scenario, the Soviet Union could be successful in achieving agricultural reforms, and the annual rate of growth in coarse-grain production could rise to 150 per cent of the 1961-86 trend. In the low-production scenario, the current plan to increase production could fail to meet the target, and growth in production would be only half the 1961-86 trend.

Consumption — Meat consumption per capita in the Soviet Union is well below the per-capita consumption in Eastern Europe, and it is not expected to increase dramatically in the projection period. In their "New Food Program," the Soviet authorities have as their target to increase the consumption of meat and meat products to 70 kg per capita by 1990.[13] Given our estimates, this target does not seem likely to be achieved. As a result, the consumption of feed grains is expected to be stabilized at around 120 million tonnes.

Currently the Soviet Union uses more feed per animal than many industrialized countries: "for example, 9 to 10 kg of feed had to be used, in 1980, to produce a 1 kg liveweight gain in pig meat. Only half that amount of grain was used for the same result in the USA."[14] If the Soviets achieve feed efficiency, however, which is another target of the New Food Program, total feed use might be lowered. Depending on all these factors, the consumption of coarse grains in the Soviet Union could amount to somewhere between 113 and 128 million tonnes in 1995.

Trade — In the 1960s, the Soviet Union was a small net exporter of coarse grains – with a million tonnes of net exports in 1960. The change in Soviet policy in the early 1970s affected the net trade position significantly. This new era was marked by a rapid increase in livestock feeding and a desire to protect the herd size from fluctuating domestic-grain production. In 1970, the Soviet Union imported 2 million tonnes of coarse grains. During the next two crop years, the Soviets experienced a poor grain crop, and in 1973 their coarse-grain imports jumped up to 8 million tonnes.[15] In the late 1970s and early 1980s, Soviet imports kept rising in a rather erratic manner. Coarse-grain imports amounted to 18 million tonnes in 1980, 26 million tonnes in 1981,

Table 4-5

Projected Coarse-Grain Production, Consumption, and Trade in the Soviet Union to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	100.0	112.4	128.0
Consumption	112.0	120.0	126.3
Trade[1]	–13.7	–7.6	1.6

[1] Net imports (–) and exports (+), based on excess demand or excess supply.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Table 4-6

Projected Coarse-Grain Production, Consumption, and Trade in Eastern Europe to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	68.5	79.1	86.5
Consumption	72.5	74.1	78.9
Trade[1]	–3.6	5.0	7.6

[1] Net imports (–) and exports (+), based on excess demand or excess supply.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

12 million tonnes in 1983, and 27 million tonnes in 1984; then they fell to 13.7 million tonnes in 1985.[16] In the New Food Program of 1982, Soviet authorities targeted an increase in the consumption of meat and meat products, and self-sufficiency in the grains and livestock sectors. Our projections show that by 1995 red meat consumption per capita will be only 56 kg and that Soviet grain production will be inadequate to satisfy the feed requirements of this lower-level consumption. The results of the most likely scenario show that the Soviet Union will remain as a net importer of coarse grains until 1994; however, the volume of imports will decline steadily. It is projected that the Soviets will import 7.6 and 0.1 million tonnes in 1990 and 1993, respectively, and will start exporting again in 1994. Soviet exports in 1995 are projected to equal 1.6 million tonnes.

Eastern Europe

Production — In Eastern Europe coarse-grain production has doubled since 1961. The climate and land of the countries in the region are well suited to corn and barley production, and they have experienced some success with agricultural reorganization. In the most likely scenario, as the reforms continue, coarse-grain production is likely to continue to grow at the 1961-86 trend rate. Many of the easy gains to increase production have already been made, so it is somewhat unlikely that production will exceed that growth rate. On the other hand, it is possible that physical production constraints may limit growth to one-half the 1961-86 trend.

Consumption — In some of the Eastern European countries, red meat consumption per capita is the highest in the world – approximately 100 kg per capita in West Germany, 80 kg in Czechoslovakia, and an average of 67 kg for the group. Average meat consumption per capita in the region is expected to exceed 80 kg; however, this increase in meat consumption will not likely increase the demand for coarse grains significantly. One of the reasons is the utilization of considerable quantities of domestically produced wheat for animal feed; in 1985, about 36 per cent of total wheat consumption was used for feed.[17]

Trade — During the last decade, the production of coarse grains in the Eastern European countries increased steadily, whereas consumption stabilized at around 71 million tonnes. These developments caused a decline in the region's imports. The net imports went down from 9.7 million tonnes in 1979 to 0.6 million tonnes in 1984, although the poor crop in 1985 pushed imports back up to 3.6 million tonnes. Given the production and consumption projections, the region is expected to become a net exporter in the near future.

Argentina, Brazil, and Mexico

Production — Argentina has a climate and land base very well suited to cereal production. The government intends to exploit this comparative advantage to improve economic conditions in the country. In an attempt to develop agriculture, the government has significantly reduced the export

Table 4-7

Projected Coarse-Grain Production, Consumption, and Trade in Argentina, Brazil, and Mexico to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected	
		1990	1995
	(Millions of tonnes)		
Production	52.5	50.7	55.5
Argentina	17.1	11.3	12.0
Brazil	20.7	24.9	27.6
Mexico	14.7	14.5	15.9
Consumption	49.9	57.4	69.0
Argentina	7.9	8.4	9.2
Brazil	23.7	28.2	35.1
Mexico	18.3	20.8	24.7
Trade[1]	4.9	–6.7	–13.6
Argentina	9.4	2.9	2.8
Brazil	–2.1	–3.3	–7.6
Mexico	–2.4	–6.3	–8.8

1 Net imports (–) and exports (+), based on excess demand or excess supply.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

tax on grain exports and has introduced an operating credit program for grain producers. Unfortunately, given the very low world prices and a government with very limited means, agricultural production will probably decrease rather than increase. Given the past history of supply response in the 1969-72 and the 1977-79 periods, it is likely that production will decline by between 10 and 20 per cent, with little prospect of growth until prices increase. In the most likely scenario, it is assumed that production will decline to 11.3 million tonnes, stay constant until prices start to pick up again in 1992, and then rise to 12 million tonnes.

Coarse-grain production in Brazil has more than doubled since 1961. Given the high demand for grains and the continued support for agriculture, it is most likely that this trend will continue in the future. If support for agriculture becomes too expensive, however, given the depressed export prices, it is possible that growth in Brazil will stall until prices increase.

Mexico has become a significant producer of coarse grains, having increased production from 6.1 million tonnes in 1961 to 18.9 million tonnes in 1986. Given the low grain prices, it is unlikely that this growth can be maintained. At best, Mexico may achieve one-half the previous growth rate. It is most likely that a leveling-off of production at the current level – 14.5 million tonnes – will be experienced. At worst, Mexico could experience a 10-per-cent drop in production, with no growth until prices increase.

Consumption — Red meat consumption in Argentina is already the second highest in the world, at 93 kg per capita, and is projected to level out at around 95 kg. In Brazil, per-capita consumption in 1985 amounted to 20.4 kg and is expected to rise to 26 kg by 1995. In Mexico, red meat consumption per capita is expected to increase from 16.8 kg in 1985 to 18.4 kg in 1995. The projected consumption of coarse grains in those countries is summarized in Table 4-7.

Trade — Despite the projected decline in production, Argentina will maintain its position as a net exporter but with lower levels of exports. Import demand in Brazil and Mexico will increase steadily. As a result of the projected developments in production and consumption, the region is expected to become a net importer in the near future.

Rest of the World

Production — In 1985, production in all other countries not previously discussed – namely, the rest of the world – accounted for 18 per cent of total coarse-grain production in the world. Production in that group of countries is assumed to continue growing at the 1961-86 trend rate. Given the assumption that major producing countries will cut and stabilize their production levels until prices start rising, the ROW is projected to produce 20 per cent of total coarse-grain output in the future.

Consumption — As of 1985, the ROW consumed 25 per cent of the coarse grains utilized globally. Since the ROW is treated as an aggregate group, studying changes in their consumption patterns was not possible. For simplicity, it was assumed that consumption would grow at the same rate as the world average.

Trade — There is no meaningful way to evaluate the trade position of a heterogeneous group of countries in aggregate. Some of those countries, such as South Africa,

Table 4-8

Projected Coarse-Grain Production, Consumption, and Trade in the Rest of the World to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	154.3	168.9	197.1
Consumption	188.4	229.3	273.6
Trade[1]	52.7	60.3	76.5

[1] Net imports required to meet the demand for coarse grains.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

Table 4-9

Projections of the World's Coarse-Grain Production, Consumption, and Trade, and Year-End Stocks to 1990 and 1995: The Most Likely Scenario

	Actual, 1985	Projected 1990	Projected 1995
	(Millions of tonnes)		
Production	845.8	836.2	943.2
Consumption	770.6	862.5	962.0
Trade[1]	83.4	77.9	93.0
Year-end stocks	183.0	152.7	81.0
	(Per cent)		
Stocks as a proportion of utilization	23.8	18.0	8.0

[1] Exports required to meet import demand.

SOURCE Estimates by the authors, based on 1985 figures from the Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and from the U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

will be net exporters; others, such as India, will be net importers. All that can be said is that this group has historically been a net importer and will remain so in the future.

Coarse Grains: Projections to 1995

An aggregation of the projections presented earlier in this chapter yield forecasts of the world's coarse-grain production, consumption, trade, and stocks.

Over the last 25 years, coarse-grain production and consumption in the world increased steadily. They did not increase at the same rate, however, and the different rates of growth in production and consumption created fluctuations in world stocks and in the stock/use ratio. Stocks, as a proportion of utilization, were as low as 9.7 per cent in 1973/74 and as high as 23.8 per cent in 1985/86. This variability in the stock/use ratio has caused price variability. Past data show that when the stock/use ratio was below 16 per cent, corn prices exceeded the loan rate; yet there was no significant difference between the price and the loan rate when the stock/use ratio was above 16 per cent.

In this report, changes in production policies and prices are assumed to be governed by changes in the stock/use ratio. The results of our projections show a significant decline in world production of coarse grains, from the 845.8 million tonnes in 1985 to 836.2 million tonnes by 1990. World consumption of coarse grains, on the other hand, will keep growing in response to population and income growth. Consumption is projected to increase from the 770.6 million tonnes in 1985 to 862.5 million tonnes in 1990 and to 962 million tonnes in 1995. These two developments are expected to bring world stocks down over time. Stocks are projected to remain high until 1991 and to fall to 13 per cent by 1995. In response to falling stocks and to the expected price rise, major producing countries will move to the high-production scenario, and total production will rise from 845.7 million tonnes in 1991 to 943.2 million tonnes in 1995. The effects of these developments on world stocks and trade are summarized in Table 4-9.

The results of the most likely scenario show that over the projection period, total import demand will exceed total export supply. World stocks of coarse grains will, however, still be more than adequate to make up the difference between import demand and export supply, and import demand will determine the volume of world trade. The implication of this is that the export figures reported in Tables 4-1 to 4-8 are lower than the actual quantities that those countries could export. The volume of exports will depend on each country's stock-holding policy and on international agreements governing world trade in the future. Therefore, this analysis does not enable us to predict the stocks that will be held in each individual country or region, or the market shares of major exporting countries.

What the model does predict is the aggregate excess supply and excess demand.

As was pointed out in the previous section, the results of this analysis are very sensitive to future developments in China. Up to now, it has been assumed that Chinese consumption would grow at the low projected rates. If China is assumed to continue growing at the current annual rate or to achieve higher growth rates, coarse-grain consumption, trade, and stocks in the world will change significantly. The results of these two scenarios, with everything else remaining constant, are summarized in Table 4-10.

These two scenarios predict that China will import 5 to 6 million tonnes of coarse grains, or its equivalent in meat, in 1990. Chinese imports are expected to increase to between 29 and 34 million tonnes by 1995 if higher growth rates are achieved. It is very unlikely that China, because of its limited transportation and handling capacity, could import around 30 million tonnes of coarse grains. For that reason, we did not take into account the impact of that kind of demand shock on world production. Given the high production volume, this scenario projects that world stocks will be completely depleted by 1994 and that export supply will put the lid on the volume of world trade. Therefore, we observe a decline in world trade in Table 4-10, while projected total import demand exceeds 120 million tonnes. This implies that if it were physically possible to produce more than the level projected by the high-production scenario, world trade could amount to 125 million tonnes in 1995.

Table 4-10

Projections of the World's Coarse-Grain Production, Consumption, and Trade, and Year-End Stocks, Based on Current or High Growth Rates in China, 1990 and 1995

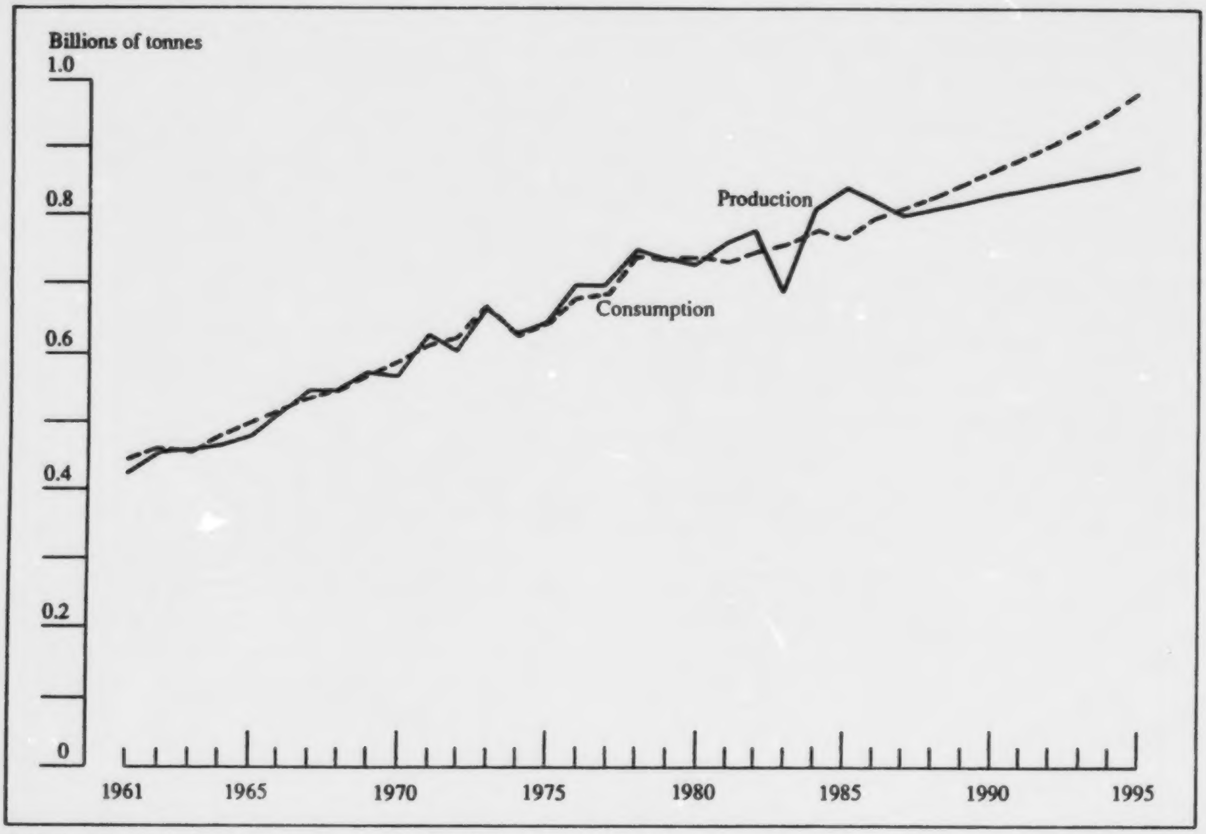
	Projections based on rate of growth in China			
	1990		1995	
	Current	High	Current	High
	(Millions of tonnes)			
Production	863.0	863.0	943.2	943.2
Consumption	870.9	872.3	990.1	995.0
Trade[1]	87.8	91.8	77.6	73.0
Year-end stocks	121.6	112.8	–	–
	(Per cent)			
Stocks as a proportion of utilization	14.0	13.0	–	–

[1] Exports required to meet import demand.

SOURCE Estimates by the authors of this study.

Chart 4-1

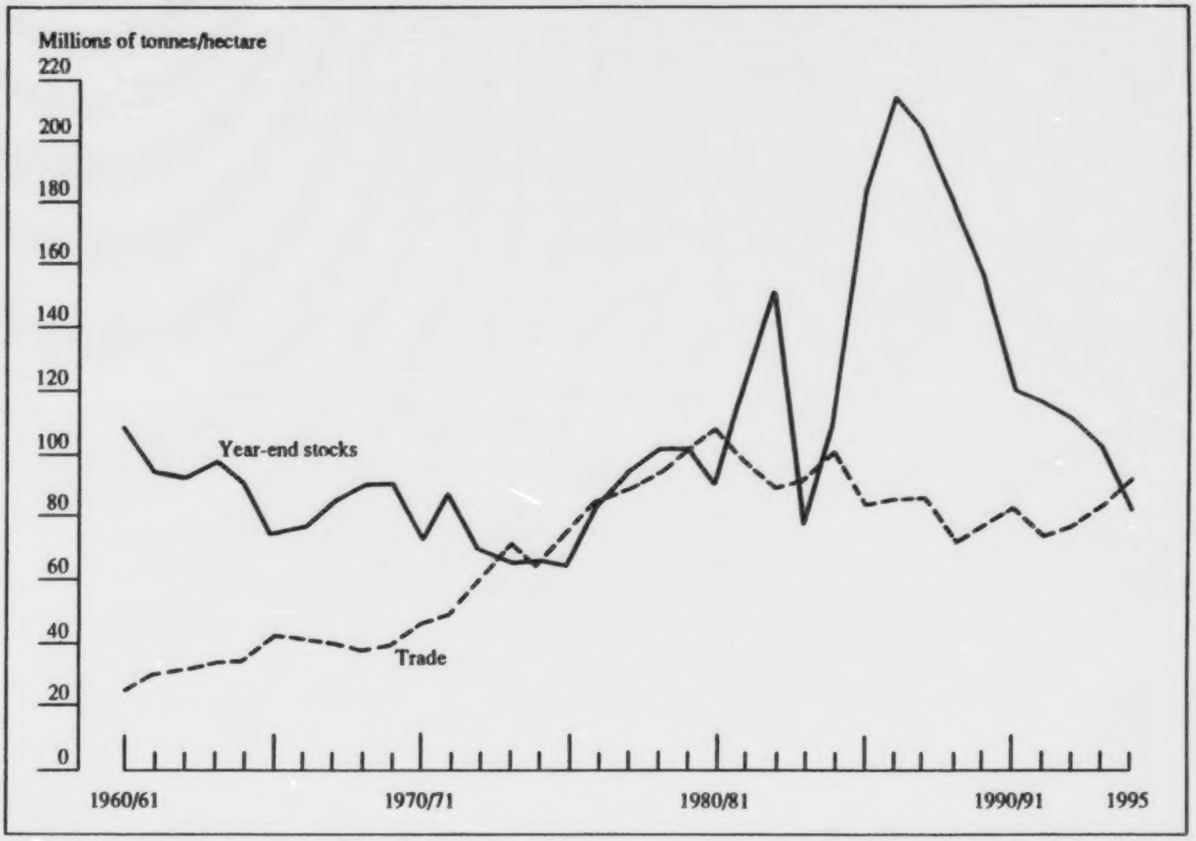
Actual and Projected Worldwide Production and Consumption of Coarse Grains, 1961-95: The Most Likely Scenario



SOURCE Estimates by the authors based on data for 1961-86 from Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, various issues.

Chart 4-2

Actual and Projected Worldwide Trade in Coarse Grains, and Year-End Stocks, 1961-95: The Most Likely Scenario



SOURCE Estimates by the authors based on data for 1961-86 from Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, various issues.

5 The Oilseed Economy of the World

The oilseed economy of the world has grown at a pace exceeding that of the wheat and feed-grain economies. Production and trade have expanded to meet the growing demand for fats and oils, and protein meals – the result of population growth and rising incomes.

The international oilseed economy is diverse and complex. Most vegetable oils and protein meals are joint products. Vegetable oils and meals are produced from oilseeds and nuts, and from marine sources, while animal fats originate from milk and meat production. Each of the various fats and oils, and protein meals, has a different characteristic that affects its demand and use. As a result, the products are close, but not perfect, substitutes. This provides opportunities for product differentiation – and hence market and trade competition.

Another important factor is the wide variations in the oil and meal composition of the different oilseeds. For example, soybeans are 17 to 18 per cent oil and 80 per cent meal, compared with canola/rapeseed, which is 39 to 41 per cent oil and 58 to 60 per cent meal. Since the market demands for oil and meal are quite independent and are influenced by largely different economic factors, this means that the value of the various oilseeds can differ sharply.

Since the main purpose of this chapter is to evaluate the future economic prospects for canola/rapeseed and flaxseed, it is important to examine the growth and changing structure of the international oilseed economy.

World Production

The world production of fats and oils increased by 137 per cent between 1960 and 1985, from 28.8 to 68.2 million tonnes. That means it increased at the rate of approximately 1.52 million tonnes per year. By comparison, the world production of wheat increased by 132 per cent; that of feed grains, by 92 per cent.

The world production of oilmeal increased by over 200 per cent between 1960 and 1985, or at the rate of 2.71 million tonnes per year, outstripping the production increase for fats and oils. That can be explained by the changing composition of oilseed production in the world. It increased from 72.2 million tonnes in 1960/61 to 190.5 million tonnes in 1985/86 – an increase of 164 per cent. In the same period, soybean production increased from 24.6 to 97.7 million tonnes. The soybean share of oilseed production increased from 35 per cent to approximately 51 per cent. Since the meal/oil composition of soybeans is approximately 4:1, that tends to explain why the production of meal increased faster than the production of vegetable oil. Canola/rapeseed is the only other commodity that has shown an increase in its share of oilseed production, having risen from about 5.0 to 9.5 per cent between 1960/61 and 1985/86. Cottonseed, groundnuts, sunflowerseed, and palm kernels have shown an upward trend in production. In contrast, flaxseed (linseed) production declined by about 10 per cent over the 1960-85 period.

World Trade

World trade in oilseeds has expanded faster than production. The export trade increased from 10.3 million tonnes in 1960 to 33.5 million tonnes in 1985. World trade as a proportion of production remained relatively constant, having only increased from 14.2 per cent in 1960 to 17.5 per cent in 1985. Soybeans are the dominant export crop, representing 76 per cent (25.4 million tonnes) of total world trade. Canola/rapeseed occupies second place at 9.7 per cent (3.2 million tonnes). Flaxseed accounts for only 1.9 per cent (0.6 million tonnes).

World trade in fats and oils has increased much faster than that in oilseeds. (Trade has also increased relative to production – by 295 per cent.) It grew from 5.5 million tonnes in 1960 to 21.7 million tonnes in 1985. Trade in 1985 stood at 31.8 per cent of production, compared with 19 per cent in 1960.

What explains the fact that trade in fats and oils increased faster than in oilseeds? Usually countries want to import raw products and capture the value added through processing. That has occurred in the wheat economy, with the decline in the flour trade. It suggests that countries producing a surplus of oilseeds – for example, Brazil and Argentina – have developed policies to restrict exports of seed and to support domestic processing. That explanation has interesting implications for Canada, which traditionally has done little to develop policies that would support domestic processing. This question will be explored at greater length later on.

World trade in protein meals has outpaced even that in fats and oils, having increased by 560 per cent between 1960 and 1985. It has expanded from 5.8 million tonnes to 38.4 million tonnes. In relation to world production, trade in meal increased from 16.7 per cent to 33 per cent. Soybeans dominated the meal trade with 72 per cent of the market in 1985. Rapeseed meal ranks third with 3 per cent of the market, behind sunflowerseed meal at 3.8 per cent. Exports of linseed meal have not changed in over 25 years. They currently take 1.7 per cent of the market, whereas they accounted for 10 per cent of world trade in 1960.

World Consumption

Countries differ widely in their per-capita consumption of fats and oils. Based on 1975 data, per-capita consumption was 20.1 kg in North America, 24.5 kg in the European Community, and 10.3 kg in other western developed countries. Per-capita demand was 15.6 kg in the Soviet Union and 18.1 in Eastern Europe. In the developing countries, per-capita demand was 8.9 kg in Latin America (7.4 kg in Brazil), 4.5 kg in Africa, 4.6 kg in the Far East (5.6 kg in India and 2.2 kg in Indonesia), and 4.1 kg in China.

World consumption of fats and oils reached 65.4 million tonnes in 1985, which was an increase of 127 per cent over the 28.8 million tonnes consumed in 1960. Consumption has been increasing slightly faster than population. In 1960, per-capita consumption was 9.6 kg on a world basis, having reached 10.5 kg in 1970, 12.4 kg in 1980, and 13.1 kg in 1985. The per-capita consumption for selected countries is outlined in Table 5-1 for 1960, 1970, 1980, and 1985. The figures show the wide differences in per-capita consumption between rich and poor countries. It further shows that developed countries, even with their high levels of consumption, recorded greater increases in consumption per capita than the developing countries of India and China. Where incomes have risen, however, as in the Soviet Union, Brazil, and Japan, per-capita consumption has increased sharply.

Fats and oils, although they have many uses, are primarily used for food. Over 75 per cent of production is used for cooking, salad oils, and table spreads, as well as for manufactured products such as margarine and compound cooking fats. Industrial use comprises the remaining 25 per cent of total consumption. Soap is the most important manufactured industrial product, which utilizes the lower-priced fats. Oils with high levels of linolenic acid, such as linseed oil, which have drying properties, are used in paints and varnishes. Coconut and palm oil, which have high lauric-acid levels, are used for food and in the manufacturing of soap; in the chemical industry, they are used to manufacture fatty acids and alcohol.

Table 5-1

Per-Capita Consumption of Fats and Oils, Selected Countries and Years, 1960-85

	Per-capita consumption			
	1960	1970	1980	1985
	(Kilograms)			
Canada	25.7	28.1	26.3	31.9
United States	28.5	32.6	35.0	39.1
European Community	28.6	31.7	35.4	38.6
Other Western European countries	22.0	23.6	25.8	27.1*
Soviet Union	13.7	17.7	20.2	22.5
Japan	7.0	9.6	15.5	18.5
Brazil	5.9	8.1	15.9	16.5
China	2.5	2.7	4.7	6.1
India	5.8	5.5	6.6	7.2
Indonesia	2.7	3.2	5.7	8.1
World	9.6	10.5	12.4	13.1

* Excluding Spain and Portugal.

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years.

Meals and oilcake are used primarily for livestock and poultry feed, although in certain countries (Japan and China), they are used directly for human consumption and as fertilizer. The demand for protein meals is therefore very largely dependent upon the increase in livestock production. Demand is further influenced by the type of livestock and by the production and technology adopted in feeding.

Meals and oilcakes are a very heterogeneous group of commodities. The protein and roughage content vary considerably. Protein content ranges from over 60 per cent in fishmeal to 40 to 50 per cent in soymeal and groundnut cake, and to 30 to 40 per cent in cotton, rapeseed, sunflowerseed, and linseed meal and cake. Also, the digestibility of the protein that the different types of livestock are being fed varies between the meals and cakes. The type of processing used adds further to quality differences – as, for example, in the solvent-versus-expeller processing methods. For example, linseed meal has approximately 1 per cent oil residue versus approximately 5 per cent in linseed cake. That results in a specialized demand for linseed cake.

Since protein meals and cakes are fed in conjunction with feed grains to produce a certain level of protein in total feed, the protein level and quality of the feed grain used affects the demand for quantity and the type of meal. The protein level of feed grains ranges from 9 per cent in maize to 10 to 11 per cent in barley, to between 11 and 14 per cent in wheat.

The production of livestock is dependent upon the demand for livestock products (meat, milk, eggs, hides and skins, and so on). Demand for those products is dependent upon the level of income and the population growth, as well as upon changes in tastes and preferences. Like fats and oils, the consumption of livestock products is low in low-income developing countries, where the highest percentage of caloric intake is met by lower-valued cereals and pulses. As incomes increase, significant substitution of meat and meat products for cereals takes place. The Food and Agriculture Organization, in 1975, estimated that meat consumption would range from 80 kg per capita in the developed countries to 11.6 kg per capita in the developing countries, to 28.9 kg for the centrally planned economies. Furthermore, it ranged from 127.9 kg in the United States, through 72.5 kg in the European Community, 21.4 kg in Japan, and 10.8 kg in Africa, to 5.1 kg in the developing countries of Asia and the Far East. The utilization of oilseed meals and cakes is thus closely related to the level of per-capita consumption of meat and livestock products.

Table 5-2 outlines the per-capita consumption of the 10 major oilseed meals for 1960, 1970, 1980, and 1985 by selected countries. It shows both the incredibly large increase in use between 1960 and 1985 and the wide disparity between the high-income developed countries and the low-income developing countries. In the European Community, per-capita use increased by over 2.5 times; in Japan and Canada, by close to 3 times; and in Brazil, by 4.5 times. In India, per-capita use actually declined over the 20-year period 1960-80, then it returned to its 1960 level in 1985.

Table 5-2

Per-Capita Consumption of Ten Major Oilseed Meals, Selected Countries and Years, 1960-85

	Per-capita consumption			
	1960	1970	1980	1985
	(Kilograms)			
Canada	23.0	38.0	64.7	68.0
United States	60.8	73.1	87.5	78.4
European Community	30.2	51.5	83.6	79.0
Other Western European countries	15.7	38.7	63.0	61.8*
Soviet Union	9.9	11.8	20.9	22.7
Japan	13.8	33.1	38.8	42.2
Brazil	6.1	9.0	28.3	18.6
China	5.5	4.1	6.7	10.0
India	6.8	5.6	5.0	6.7
World	11.6	15.1	20.3	20.0

* Excluding Spain and Portugal.

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years.

Prices in the Oilseed Economy

The prices of oilseeds, oil, and meal result from a complex interaction of demand and supply forces influenced by agricultural and trade policies. The markets for these commodities are influenced by the joint-product nature of the commodities; the relation of the oilseed products – through substitution in production – with wheat, feed grains, and other crops; the degree of substitution in use; the specific government programs; and the mechanism used to set prices.

The United States, because of its dominant position in the world's oilseed market and because of the relatively free trade in North America for oilseeds and products, strongly influences the price of Canadian oilseeds, oils, and meals. In addition, it is the soybean market complex that largely determines price.

The price-setting mechanism for soybeans and soybean products is the Chicago Board of Trade's (Exchange) three futures markets for soybeans, soybean oil, and soybean meal. The decision by processing firms to crush soybeans is dependent upon the purchase price of soybeans, the cost of processing, and the price of the end products – soybean oil and meal. Since soybean processors tend to hedge in the futures market to guarantee a profitable crushing margin, this tends to maintain a price relationship between the three commodities – seed, oil, and meal. Changes in the demand for, and supply of, any one of the commodities thus affect the price of the others.

Of the two commodities, soybean oil is regarded as a close substitute for both canola oil and linseed oil, as is soybean meal for canola and linseed meal. The prices of all three commodities are expected to be closely related.

In Canada, futures markets exist for canola (rapeseed) and flaxseed on the Winnipeg Commodity Exchange. Unlike in the United States, there is no futures market for soybean oil and meal. Canadian oilseed processors are known to hedge their canola oil and meal on the U.S. futures markets for soybean oil and meal. The price of soybeans, canola, and flaxseed should differ largely because of the differences in oil and meal content. In addition, Canadian and U.S. prices will differ because of exchange rates and trade impediments, which, as stated previously, tend to be minor. Also, Canadian canola and flaxseed can be priced at a premium or at a discount to soybeans, depending upon the relative scarcity of the Canadian products. This will be explained later.

The following correlation coefficients between prices illustrate the degree of relatedness of the various commodities: Canadian canola and U.S. soybeans, +0.92; and Canadian flaxseed and U.S. soybeans, +0.81.

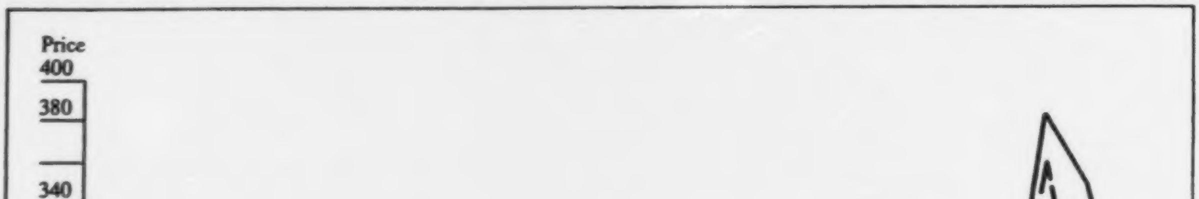
The relationship for the 1960-85 period for Canadian canola and U.S. soybeans is shown in Chart 5-1; for Canadian rapeseed and flaxseed, in Chart 5-2.

Houck *et al.* (1972) reported correlation coefficients for the 1951-67 period, as follows: soybean meal and soybean oil, +0.03; soybean meal and linseed meal, +0.68; soybeans and soybean meal, +0.83; and soybeans and soybean oil, +0.35.

These statistics illustrate the lack of relationship between meal and oil, and the much closer relationship between soybeans and soybean meal than between soybeans and soybean oil.

Chart 5-1

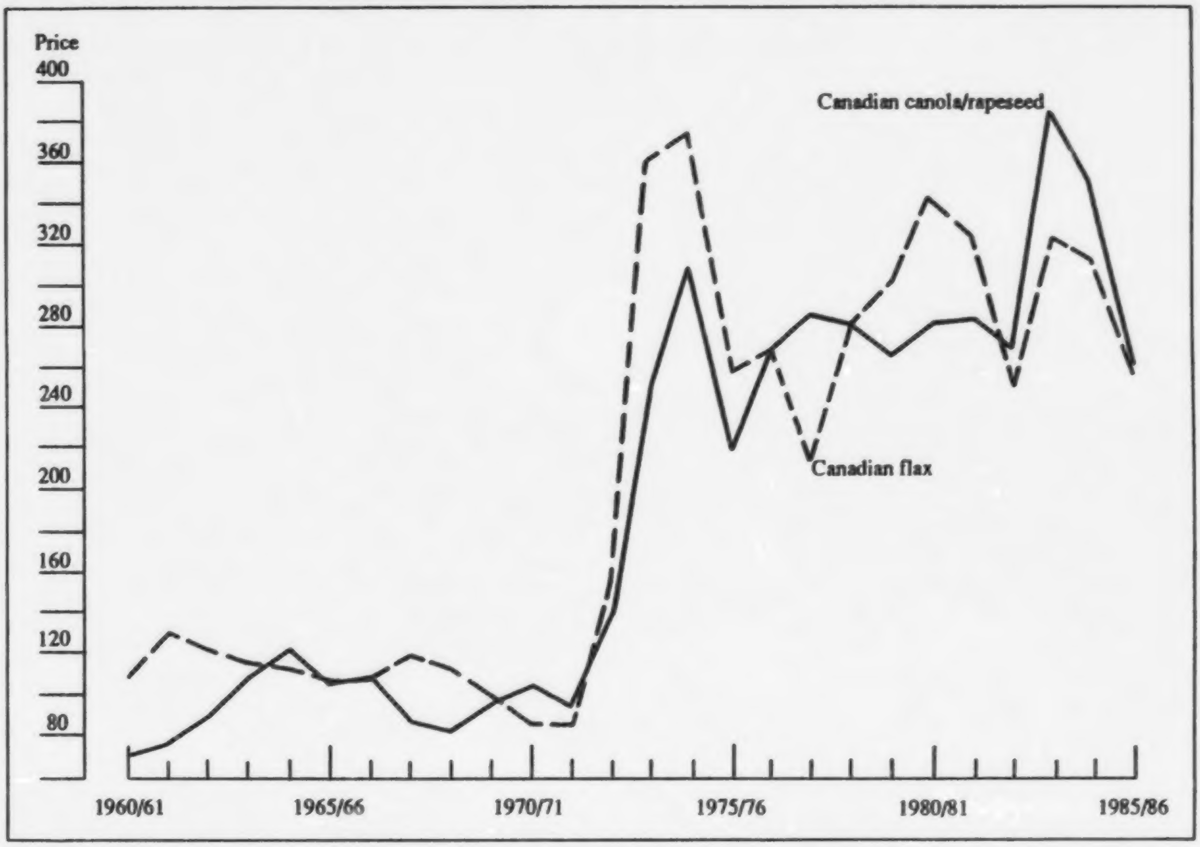
Canadian Canola/Rapeseed Prices versus U.S. Soybean Prices, Crop Years 1960/61 to 1985/86



SOURCE U.S. Department of Agriculture, Economic Research Service, *Fats and Oils Situation*, Washington, D.C., selected years.

Chart 5-2

Canadian Canola/Rapeseed Prices versus Flaxseed Prices, Crop Years 1960/61 to 1985/86



SOURCE Canadian Grains Industry, *Statistical Handbook*, Winnipeg, Canada Grains Council, selected years.

The future of canola and flaxseed in western Canada is largely dependent on the relative profitability of these crops compared with their major substitutes, wheat and barley. The planting decisions of farmers are influenced primarily by comparisons of the expected prices of the different crops, by market prospects, and by government programs. An increase in the expected price of canola (and flaxseed) relative to wheat and barley will normally result in an increased seeded acreage of canola (flaxseed) and vice versa. The same relationship holds particularly between soybeans and corn in the United States and, to a lesser extent, between wheat and soybeans. The following correlation coefficients (*r*) show how closely these prices are related: U.S. soybeans and U.S. corn, 0.91; U.S. soybeans and U.S. wheat, 0.81; and U.S. corn and U.S. wheat, 0.92.

As explained earlier, the U.S. and Canadian markets are closely related as illustrated: Canadian wheat and U.S. wheat, 0.95; Canadian barley and U.S. corn, 0.91; Canadian barley and U.S. barley, 0.95; and Canadian canola and U.S. corn, 0.90.

The other major factors affecting the relative profitability of producing canola and flaxseed are the changes in relative yields and costs of production. Both factors are determined largely by changes in technology and management. This is discussed further in subsequent sections.

Country and Regional Assessments

Canada

Canola/rapeseed has become one of the most important crops produced in Canada. In 1986 it generated $698.6 million in farm cash receipts ($905.8 million in 1985);

flaxseed, $134.9 million ($194.2 million in 1985). Soybeans generated $227.6 million, but that was entirely from Ontario. These receipts amounted to $775.4 million for barley and $2,817.3 million for wheat. Cash receipts from canola/rapeseed exceeds those for barley in both Manitoba and Alberta.

The growth in the Canadian oilseed economy, particularly rapeseed, has converted Canada from being a net importer to a net exporter. In 1986, Canada's trade balance in oilseeds and oilseed products was $470.5 million (exports, $925.7 million; imports, $455.2 million). By comparison, the trade balance represented a net surplus of $120.1 million for the 1971-75 period; however, Canada still maintains a net deficit position of $121.0 million in oilseed products. In 1986, Canada imported 330.3 million dollars' worth of oilseed products, of which $167.8 million was for soybean cake and meal.

Canola/Rapeseed — The structure of western Canada's oilseed economy can best be described by the use of a supply/demand table. Five-year averages are shown for canola/rapeseed in Table 5-3. In the 1960-64 period, canola/rapeseed production averaged 226 thousand tonnes. In 20 years, production expanded by over tenfold to 2,519 thousand tonnes. In 1986/87, production amounted to 3,887 thousand tonnes. Exports rose from 160 to 1,391 thousand tonnes in the same 20-year period, and to 1,800 thousand tonnes in 1986/87. The quantity crushed for oil and meal grew from 36 thousand tonnes in the early 1960s to 1,350 thousand tonnes. Total domestic use (crushing, seed, waste, and dockage) is approximately equal to exports. One of the most significant features of the canola/rapeseed industry has been the growth in domestic utilization. Canada was primarily dependent upon imported oilseeds and upon oil and meal products prior to rapeseed's emergence after the Second World War. The quantity of canola/rapeseed that was crushed relative to exports increased from 18 per cent in 1960/61 to 42 per cent in 1986/87.

Rapeseed was first developed in Canada for the lubrication properties of its oil: however, it has been its demand as an edible oil and a source of protein for livestock feed that has spurred its development. That eventually led to a major modification of the structural properties of rapeseed. First, plant breeders located in western Canada developed rapeseed varieties that were free of erucic acid. This compound, which comprised 23.5 per cent of the fatty-acid composition of rapeseed, was eliminated. Erucic acid had been diagnosed as causing heart lesions in rats, and the industry responded by eliminating erucic acid in order to preserve and protect its market. The new varieties were called "O-free" – that is, free of erucic acid.

Originally, rapeseed contained a thyrotoxic substance called "glucosinolates" that restricted its use in livestock

Table 5-3

Canola/Rapeseed Supply and Demand, Canada, Crop Years 1960/61 to 1986/87

	Supply			Demand		
	Stocks on August 1st	Production	Total supply	Exports	Domestic consumption	Quantity crushed in Canada
			(Thousands of tonnes)			
Five-year averages:						
1960-65	18.8	225.9	244.7	160.1	60.3	35.9
1965-70	115.8	571.1	686.8	346.0	214.3	129.6
1970-75	408.6	1,495.5	1,904.3	947.1	481.9	286.3
1975-80	609.5	2,207.1	2,816.7	1,238.0	843.1	629.8
1980-85	808.6	2,518.8	3,342.6	1,391.2	1,340.0	1,060.4
Crop year:						
1985/86	470.0	3,508.0	3,988.0	1,456.0	1,553.0	1,211.0
1986/87	978.0	3,887.0	4,865.0	1,800.0	1,700.0	1,350.0

SOURCE: Canadian Grains Industry, *Statistical Handbook*, Winnipeg: Canada Grains Council, selected years.

and poultry feeds. Researchers succeeded in developing glucosinolate-free varieties that improved the acceptability and market for rapeseed meal.

The new varieties, free of both undesirable compounds, were referred to as "double zero." In order to distinguish the "new rapeseed" oilseed varieties – and hence the "new oil and meal" – the industry adopted the name canola.

Canola oil has made strong inroads into the Canadian vegetable-oil market, as outlined in Table 5-4. Its share of this growing market increased from 27.8 per cent in 1970 to 54.5 per cent in 1984. It gained at the expense of all oils, although the soybean-oil share declined the most, from 39 to 28.5 per cent over the 1970-84 period.

The substitution of margarine for butter in the Canadian diet also increased the demand for vegetable oils. The per-capita consumption of margarine increased from 4.22 kg in 1960 to 6.08 kg in 1984. As a result, margarine production doubled from 75.6 thousand tonnes to 153 thousand tonnes. By comparison, per-capita butter consumption declined from 7.34 kg in 1960 to 4.21 kg in 1984. In addition, salad oil consumption per capita increased from 1.42 kg to 4.41 kg; shortening and shortening oils, from 4.23 kg to 8.04 kg. Canola oil is heavily utilized in all three products – margarine, shortening, and salad oil. With the growing concern over cholesterol levels, canola oil, with its highly polyunsaturated characteristics, is likely to capture an increased market share.

Table 5-4

Canadian Canola/Rapeseed and Soybean Shares of the Vegetable-Oil Market, Selected Years, 1970-87

	Market share, by type of oilseed				
	1970	1975	1980	1984	1987
	(Per cent)				
Canola/rapeseed	27.8	32.7	46.8	54.5	61.1
Soybeans	39.0	36.4	31.9	28.5	24.9
Palm and palm kernels	6.7	11.5	4.1	3.4	2.2
Coconut	6.3	5.8	3.2	2.1	2.4
Other	20.2	13.6	14.0	11.4	9.4

SOURCE Peter Perkins, "An economic review of western Canada's rapeseed processing industry," an unpublished consultants' report prepared for the provincial governments of Alberta, Saskatchewan and Manitoba, and rapeseed processors, November, 1976; Price Waterhouse, "Task force on the future of the canola industry," an unpublished discussion paper for the Canola Council of Canada, January 13, 1986; and Statistics Canada, *Oils and Fats*, Cat. 32-006.

The protein-meal market for livestock and poultry in Canada is dominated by soybean and canola meal. It is estimated that in 1983 the Canadian consumption of protein meal equaled 2,025 thousand tonnes, 60 per cent (1,191.8 thousand) of which was soybean meal and 20 per cent (403.1 thousand) of which was canola meal; the remainder was largely meat and bone meal.[1] The consumption of soybean and canola meals expanded from 728.9 thousand tonnes in 1970/71 to 1,594.9 thousand tonnes in 1983/84.[2] Estimates for 1985 place meal consumption at 1,721 thousand tonnes.[3]

Trade in Canola/Rapeseed and By-Products — Japan is the major importer of Canadian canola/rapeseed. Its imports of Canadian seed increased from 101.3 thousand tonnes in 1965 to 1,408.9 thousand tonnes in 1986. In that period, Japan's share of the Canadian export market ranged from 38.3 per cent (1965) to 96 per cent (1985). For the five-year period 1981/82 to 1985/86 Japan took 87.2 per cent of Canadian canola/rapeseed exports. Other importers during that period were Mexico and the Netherlands.

Although small relative to seed, exports of canola oil have increased significantly over the last 10 years. In 1984/85 Canada exported 123.8 thousand tonnes of canola oil, compared with 91.6 thousand tonnes in 1976/77. India has been Canada's major customer. In 1984/85 India imported 131.5 thousand tonnes, of which 20 thousand tonnes represented food aid.

The canola-oil export market once consisted largely of food-aid shipments; that is no longer the case, with food aid now accounting for less than 20 per cent of all exports. The major gains have been in the U.S. market. Exports to the United States increased from 4 thousand tonnes in 1984 to 49.2 thousand tonnes in 1986. That was largely the result of Canada gaining access to the U.S. vegetable-oil market following the U.S. Food and Drug Administration's decision in 1985 to grant canola oil GRAS (Generally Regarded as Safe) status.

How do canola-oil exports compare with seed exports? The 229.4 thousand tonnes of canola-oil exports are equivalent to approximately 573.5 thousand tonnes of seed (40 per cent extraction rate). In 1986, Canada exported 1,585.8 thousand tonnes of seed. The canola-oil exports were valued at $131.3 million; seed exports, at $422.3 million.[4]

Canadian exports of canola meal also increased significantly, from 22.8 thousand tonnes in 1975 to 327 thousand tonnes in 1986. The total value of exports was $56.9 million in 1986. Major importers include: United States (37 per cent); Japan (29 per cent); Indonesia (12 per cent); and South Korea (12 per cent).

Canadian Canola/Rapeseed Crushing Industry — The increased utilization of canola/rapeseed oil and meal in Canada and the increased exports would suggest a healthy crushing industry. Unfortunately that is not the case. Why?

The crushing industry expanded its capacity to keep pace with growing production. Most of the capacity has been built since 1970. In western Canada it reached 3,450 tonnes/day in 1976 and 4,450 tonnes/day in 1983, decreasing to 4,338 tonnes/day in 1984/85. In eastern Canada, canola-crushing capacity is 900 tonnes/day.

The industry is now suffering from overcapacity and periods of negative crushing margins. The Task Force on the Future of the Canola Crushing Industry states: "Western Canada plants have operated at utilization rates ranging from a low of 54.8 per cent in 1982-83 to a high of 75.7 per cent in 1984-85." Even after receiving $40.7 million in operating subsidies, the western plants had losses of $18.4 million over the six-year period 1980-86.

The profitability of the industry depends upon the gross crushing margin at the plant level and the cost of crushing. Any combination of factors that raises the price of seed relative to the price of produced oil and meal will result in reduced profits, and even losses.

Japanese demand is the major factor affecting the crushing industry. Japanese canola/rapeseed crushing expanded from 583,000 tonnes in 1972 to almost one-and-one-quarter million tonnes in 1982.[5] As rapeseed production is negligible in Japan, the country has been almost totally dependent upon imports. Canada has been the major supplier, filling over 90 per cent of Japanese crushing requirements. That has set up a situation where Canadian crushers compete with Japanese crushers for Canadian seed supplies.

Canada maintains a relatively open trade policy on seed, oil, and meal, providing little protection for Canadian crushers. Japan, in contrast, maintains a protectionist policy. It has maintained an import tariff of 17,000 yen/tonne on crude canola/rapeseed oil imports and 23,000 yen/tonne on refined oil imports. There are no import restrictions on imported seed or meal. Canada, as a result, exports very little oil and meal to Japan.

As explained later, in the section on Japan, the preference in that country for canola/rapeseed oil over other vegetable oils – e.g., soybean oil – provides Japanese crushers with a price advantage over their Canadian crushing competitors. As a result, when supplies of canola/rapeseed seed are tight, the Japanese crushers are able to bid supplies away from Canadian crushers, thus raising the price of canola/rapeseed in Canada. That reduces the domestic crushing margin and squeezes the Canadian plants, as can be seen in Chart 5-3, which shows the ratio of the canola/rapeseed price to soybean price and the ratio of canola/rapeseed stocks to domestic crushed plus exports. That is, when supplies are tight, the price of canola/rapeseed is bid up, and it sells for a premium relative to soybeans, and vice versa. Similarly, for the 1965-84 period, 43 per cent of the variation in the estimated gross annual crushing margin for canola/rapeseed can be explained by variations in the stock levels of canola/rapeseed.[6] This matches the Task Force (1986) findings that the canola crushing industry in the West suffered losses from 1982 to 1985, after having had profits in 1980 and 1981.

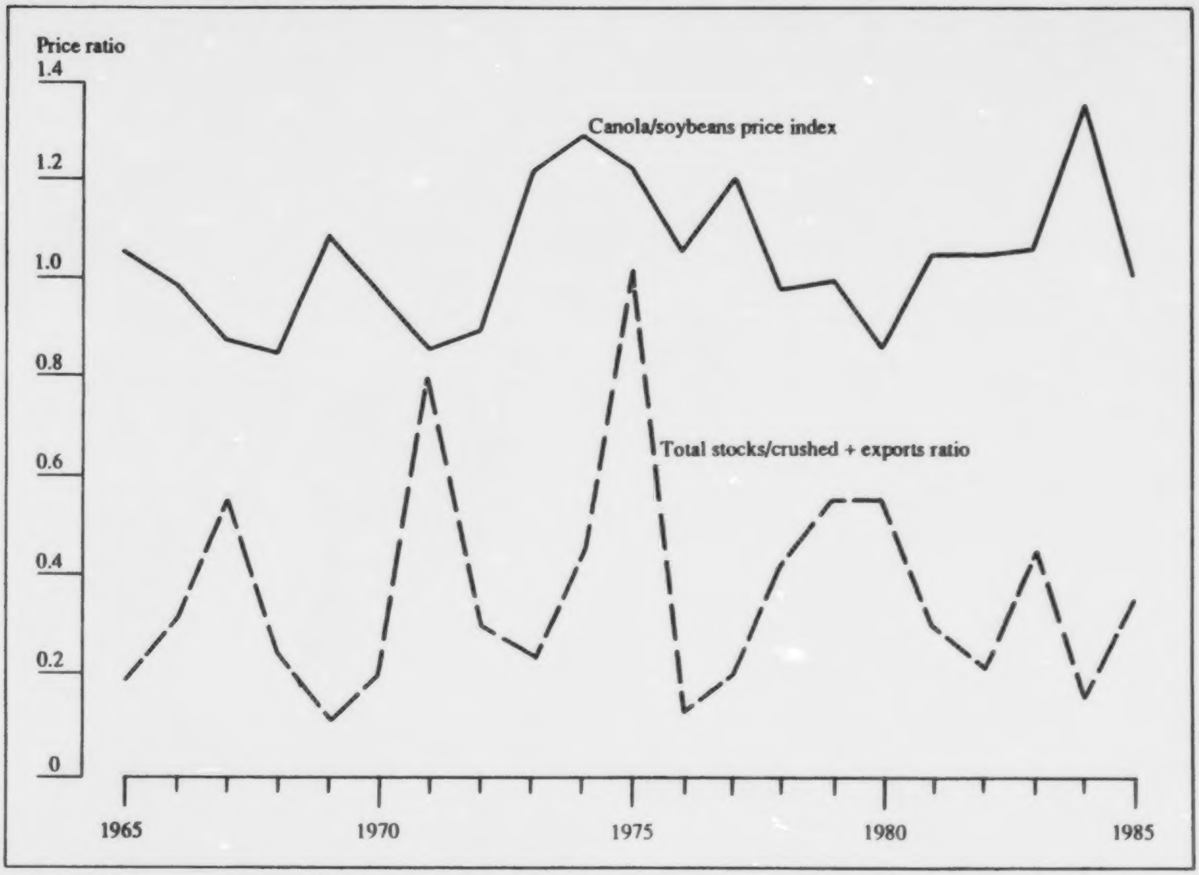
Other factors that will affect the crushing industry in the future include oilseed-policy developments in the European Community and future export markets for canola oil and meal, particularly in the United States and the Indian Subcontinent.

Flaxseed — In contrast to the growth in the canola/rapeseed industry, both in terms of production and processing, the flaxseed economy has been static and highly dependent upon the export seed market. The supply/demand table (Table 5-5) illustrates that more clearly. In the period 1965-70, flaxseed production averaged 411 thousand tonnes, compared with 742 thousand tonnes in the period 1980-85. The increased production was largely the result of increased yields, as acreage actually declined from 1,824 thousand to 1,384 thousand. From 1964 to 1970, 407 thousand tonnes were exported, compared with only 61 thousand tonnes that were crushed. An additional 78 thousand tonnes were accounted for as seed, waste, and dockage. Although Statistics Canada ceased to report crushings after 1974, crushings of flaxseed in Canada remains at an insignificant level. There are two types of flaxseed in the world: one is grown primarily for its fibre; the other, for its seed, which is used to produce linseed oil and linseed cake and meal. Linseed oil has unique drying properties and has thus been used for coating purposes in paints, varnishes, lacquers, and the production of linoleum, oilcloth inks, and other imported products. In addition, flaxseed fibre from the seed-type varieties is used for various purposes but primarily for cigarette-paper production.

The drying properties of linseed oil come from its high linolenic-acid (55 to 60 per cent) and its high iodine content, which rapidly provides a film over coated substances. The

Chart 5-3

Index of Canola/Rapeseed Price to Soybean Price and Ratio of Crushed and Exported Canola/Rapeseed to Total Stocks, Canada, 1965-85



SOURCE U.S. Department of Agriculture, Economic Research Service, *Fats and Oils Situation*, Washington, D.C., selected years; and Canadian Grains Industry, *Statistical Handbook*, Winnipeg, Canada Grains Council, selected years.

high linolenic-acid levels prevent it from being used as an edible oil, although it is consumed in small quantities in some places, such as India. The use of linseed oil has declined in both Canada and the world, however, primarily as a result of the development of water-based paints. The other factor has been the increased use of soybean oil as a substitute for linseed oil in the manufacture of coatings. This development has largely taken place since 1974,[7] when the price of flaxseed and linseed oil skyrocketed, causing users to search for alternatives. That led to the development of technology to refine soybean oil so that it could be utilized as a substitute for linseed oil.

Two types of linseed feed are produced: linseed meal and linseed cake. Both are sources of protein for livestock; and both are low in lysine, which affects its use for pigs. Also, both have only limited use in poultry feeds because of their high vitamin B levels, which make the feed toxic. They are used primarily for feedstuffs for sheep, dairy cattle, and horses. One advantage of linseed meal and cake, where it is wanted, is its mucilaginous content, which tends to give livestock a glossy appearance. It also helps to lubricate the digestive tract and to increase water absorption. Linseed cake, with its higher oil content, is often sought out as a feedstuff for show cattle and horses.

Trade in Flaxseed, Linseed Oil, and Meal — The European Community – particularly West Germany, the United Kingdom, and the Netherlands – is the major market for Canadian flaxseed. In the 10-year period 1975-85, the European Community took 62 percent of Canadian exports.

Table 5-5

Canadian Flaxseed Supply and Demand, Crop Years 1965/66 to 1986/87

		Supply			Demand		
	Acreage	Stocks on August 1st	Production	Total supply	Exports	Domestic consumption	Quantity crushed in Canada
				(Thousands of tonnes)			
Five-year averages:							
1965-70	1,824.0	201.0	411.0	778.0	407.0	139.0	61.0
1970-75	1,860.4	322.6	615.8	938.4	470.4	135.0	59.3
1975-80	1,469.0	335.0	552.0	887.0	351.2	127.2	..
1980-85	1,384.0	362.0	742.0	922.0	526.0	102.0	..
Crop year:							
1985/86	1,830.0	144.0	905.0	1,049.0	622.0	121.0	..
1986/87	1,990.0	306.0	1,067.0	1,373.0	700.0	150.0	..

SOURCE Canadian Grains Industry, *Statistical Handbook*, Winnipeg: Canada Grains Council, selected years.

The other major markets were Japan, at 24 per cent; and the United States at 7 per cent.

Canadian exports of linseed oil and meal are negligible. Exports in 1986 amounted to 2,661 tonnes, with a value of $1.7 million.[8] The Netherlands was the major importer, at 77 per cent. Meal exports in 1986 totaled 1,897 tonnes, with a value of $407 thousand. The United States is the major importer.

Flaxseed-Crushing Industry — There are only two flaxseed-crushing plants in Canada: Alberta Linseed Oil, established in 1913 at Medicine Hat, with a capacity of 40 tonnes per day; and Maple Leaf Monarch, built at Windsor in 1980. The Alberta plant uses the expeller method of extraction. Whereas the Windsor plant's capacity is 280 tonnes per day, it uses the pre-press solvent method of extraction, which can crush flaxseed, sunflowerseed, and rapeseed.

The limited demand for linseed oil in Canada is probably the main reason why flaxseed processing has not developed. Under similar circumstances, however, Argentina developed a crushing industry and exports linseed oil and meal, primarily to Europe. The Argentine government undertook to capture the value added from processing by instituting policies to restrict the export of seed and to encourage processing. Canada has made no attempt to follow Argentina's example.

The Future of the Oilseed Economy in Western Canada — The following factors will largely determine the future for oilseed production and processing in western Canada:

- the growth in demand for, relative to the supply of, fats and oils, and protein meal (the growth in income and population, particularly in the developing countries, will largely determine the demand for fats and oils and for meal, which in turn will determine the demand for protein meal, and supply will be influenced by technological change and the potential for acreage substitution);
- canola/rapeseed and flaxseed production, which will depend upon the relative profitability of those crops versus substitute crops – particularly wheat and feed grains – which in turn will depend on relative prices and production technology; and
- agricultural and trade policies in the key producing and consuming countries – the European Community, the United States, Japan, Brazil, and Argentina – which are vital, particularly for canola/rapeseed.

Projections to 1995 — Demand projections to 1990 and to 1995 for fats and oils, and for protein meal, follow the same methodology as was outlined for wheat and coarse grains (see Appendix C). The income elasticities were estimated, using 1980-to-1984 time series and cross-sectional data from *Oil World*.

Production projections were based on various trend estimates. The trends used are explained in each table. This is one of the most simplistic approaches to forecasting. It assumes that the conditions and factors that have determined past production will continue at the same growth rate in the future. It is not clear from past forecasting results that any more-complex approach to forecasting would produce superior results.

The income elasticity of demand for fats and oils in Canada was estimated at 0.04 for 1984, based on the 1980-84 data. With the economy expected to grow at 2.4 per cent per year and population expected to increase to 26.5 million by 1990 and to 28.2 million by 1995, fat and oil consumption was projected to reach 736 thousand tonnes in 1990 and 788 tonnes in 1995 (see Table 5-6). That is actually less than the estimated consumption of 804 thousand in 1985 and may thus underestimate actual utilization.

The income elasticity of demand for different types of meal has been estimated at 0.06 for 1984. Meal utilization was forecasted to increase to 1,831 thousand tonnes by 1990 and to 1,965 thousand tonnes by 1995. That suggests further growth in meat production for Canada.

Future oilseed production in Canada will depend upon yield increases and/or upon expanded acreage. Acreage planted to oilseeds will be largely dependent on the strength of the oilseed economy relative to the wheat and feed-grain economies (see the following section on the United States for an explanation). Three projections have been made: a high projection based on the 1985 production level, plus the 25-year trend; the 25-year trend; and a low projection based on no change in production from the trend level projected for 1986/87. Canadian oilseed production in recent years has been above the 25-year trend, which suggests that Canada could conceivably expand its production at a higher rate than prevailed over the past 25 years.

Net trade figures were calculated for the 1960-85 period, with projections made to 1990 and 1995 based on the 25-year trend.

United States

The United States is the dominant force in the world's oilseed economy, both as a producer and exporter of oilseeds; however, the top-ranking oil and meal exporter is now Brazil.

In 1960/61, the United States produced 21.8 million tonnes of oilseeds (see Table 5-7); and soybeans accounted

Table 5-6

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, Canada, Selected Years, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	463	591	629	804	736	788
Oilseed meals	414	799	1,546	1,721	1,831	1,965
					(High projection)	
					5,488	6,335
					(25-year trend)	
Production	990	3,188	3,827	5,200	4,811	5,488
					(Low projection)	
					4,811	4,811
Net trade					(25-year trend)	
Oilseeds	99	671	1,421	2,025	2,271	2,665
Fats and oils	–25	22	284	290^{p}	370	451
Oilseed meals	44	–4	–79	..	–215	–333

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

Table 5-7

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, United States, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	5,159	6,687	7,977	9,322	9,030	9,407
Oilseed meals	11,006	14,994	19,920	18,714	19,609	20,458
					(High projection)	
					75,133	84,218
					(25-year trend)	
Production	21,839	36,223	55,560	67,400	75,133	84,218
					(Low projection)	
					67,865	67,865
Net trade					(25-year trend)	
Oilseeds	3,794	11,883	23,713	17,527	29,330	33,883
Fats and oils	1,627	1,690	2,673	2,128	2,287	2,446
Oilseed meals	390	3,563	7,390	. .	9,442	10,992

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

for 15.1 million tonnes (70 per cent) of that total. Soybean production continued to increase steadily in the United States, reaching a peak in 1979/80 at 61.7 million tonnes – 66 per cent of world production. Oilseed production has tended to stabilize over the last several years; in 1985/86 it reached 65.4 million tonnes, or 34 per cent of world production.

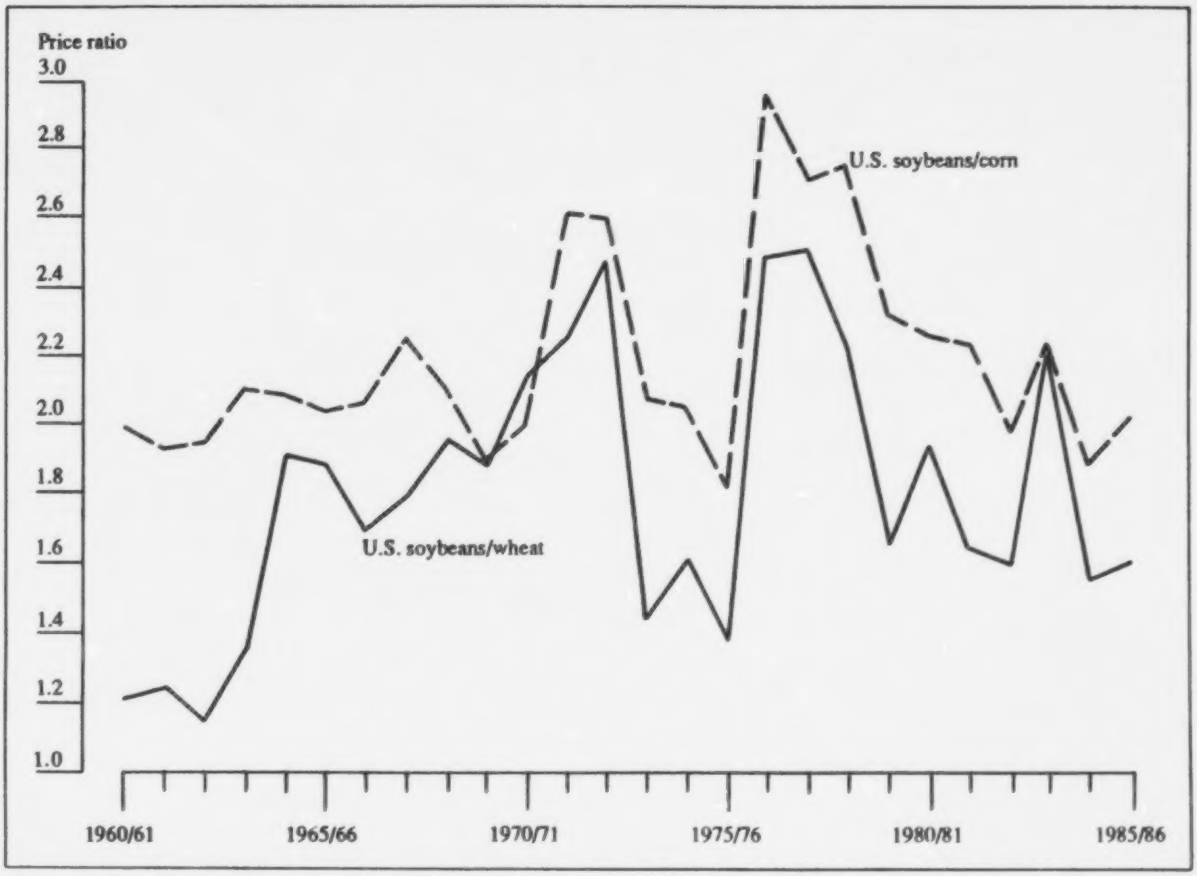
The phenomenal increase in soybean production stems from the profitability of soybeans relative to other substitute crops. In the 20-year period from 1960 to 1980, soybean acreage increased from 23.7 to 70.3 million acres. The changing prices of soybeans relative to those of corn and wheat largely explain the relative profitability. Chart 5-4 shows that the ratio of soybean prices to corn prices trended upward from 2.0 in 1960/61, reaching a peak of 2.9 in 1975/76. Soybean acreage followed that pattern closely, with appropriate lags. Following the high soybean prices relative to corn prices from 1976/77 to 1978/79, soybean acreage increased from 49.4 million acres in 1976 to 57.8 million in 1977, to 63.7 million acres in 1978, and to 70.3 million in 1979. After 1978/79, soybean prices declined relative to corn prices. As a result, harvest acreage showed a steady decline to 59.4 million acres in 1986. The ratio of soybean prices to wheat prices tended to follow a similar pattern.

The volume of demand for fats and oils also increased significantly, from 5.2 million tonnes in 1960 to 9.3 million tonnes in 1985 (see Table 5-7) – an increase of 18.1 per cent, or 7.2 per cent per year. Per-capita consumption rose from 28.5 kg in 1960 to 36.5 kg in 1985. The income elasticity was estimated at 0.029 for 1984, based on the period 1980-84. With the economy expected to grow at 1.7 per cent per year and population expected to increase to 247 million in 1990 and to 257 million in 1995, the consumption of fats and oils was projected at 9.0 million tonnes in 1990 and at 9.4 million tonnes in 1995. That would be little more than the 9.3 million tonnes in 1985; thus it may be an underestimate of the potential consumption.

The consumption of meal increased by 170 per cent, from 11.0 million tonnes in 1960 to 18.7 million tonnes in 1985. Since meal is largely used for supplemental protein in livestock and poultry rations, the increasing per-capita consumption of meal actually reflects the increasing per-capita consumption of meat and the population growth. Per-capita meal consumption increased from 60.8 kg in 1960 to 79.0 kg in 1985. The income elasticity for meal was estimated at 0.047. As a result, meal usage was projected to remain relatively constant at 79.7 kg in 1995. Total meal consumption was estimated to increase to 19.6 million tonnes in 1990 and to 20.5 million tonnes in 1995.

Chart 5-4

Soybean/Wheat and Soybean/Corn Price Ratios, United States, Crop Years 1960/61 to 1985/86



SOURCE U.S. Department of Agriculture, Economic Research Service, *Fats and Oils Situation, Wheat Situation, and Feed Situation*, Washington, D.C., selected years.

Future oilseed production in the United States will depend largely upon the improved profitability of soybeans relative to substitute crops. At the present time, as was just illustrated, the ratio of soybean prices to corn and wheat prices is declining. Should that situation reverse, the growth in soybean production that resulted up to the mid-1970s could recur. Using the 25-year (1960-85) trend in production as a forecast, soybean production could amount to 75.1 million tonnes in 1990 and to 84.2 million tonnes in 1995 (see Table 5-7). Based on the 25-year trend, soybean yields would be 857 kg/acre in 1990 and 918 kg/acre in 2000. To reach those production levels, soybean acreage would have to increase to 88 million acres by 1990 and to 91.7 million acres by 1995. That would mean a substantial reduction in corn acreage and other crop acreage. In 1986 the feed-grain acreage set aside was 18 million acres; but that was because of the high year-end stocks, because the set-aside amount had only been 7.1 million acres in 1985. It is unlikely that U.S. soybean production will reach those levels, however; it is more apt to remain relatively static at the production level projected for 1986/87, which was 67,865 thousand tonnes.

Table 5-7 outlines the extensive growth achieved in U.S. net trade for soybeans, soybean oil, and meal between 1960 and 1980. Over the last several years, however, U.S. exports have declined, particularly those of soybean meal and oil. Brazil has surpassed the United States as an exporter of both of those products. The U.S. share of the world market for soybean meal fell from 38.2 per cent in 1980 to 20.5 per cent in 1985; for soybean oil, from 34.6 per cent in 1980 to 21.2 per cent in 1985.

Table 5-7 also predicts U.S. net exports of oilseeds should the United States maintain its 25-year trend, which is not impossible if U.S. production remains on trend and if world demand should expand.

European Community[9]

Although the European Community is a net surplus producer of wheat, barley, milk, and beef, it has a large net deficit in oilseeds and oilseed products. Western Europe is the world's major user and importer of oilseeds and oilseed products, especially flaxseed and linseed oil and meal; however, oilseed production has increased dramatically in recent years, from 2.6 million tonnes in 1980 to 5.6 million tonnes in 1985, for example.

The oilseed self-sufficiency level for the period 1977-82 was 13.1 per cent; it had only been 9.1 per cent from 1957 to 1962. For that period, production amounted to 2,007 thousand tonnes; crushings, to 15,291 thousand tonnes. In 1985/86, production increased to 5,580 thousand tonnes and crushings to 21,003 thousand tonnes, raising the self-sufficiency level to 26.6 per cent. As a result of improving self-sufficiency, the net trade in oilseeds actually declined from 1980 to 1985 (see Table 5-8).

For the 17 major fats and oils, the self-sufficiency level is 93.2 per cent. Imports of oils and fats have actually declined over the last 15 years.

For the 10 major protein meals, the self-sufficiency level is much lower. Production amounted to 15 million tonnes in 1985; consumption, to 28 million tonnes. The self-sufficiency level was therefore 54 per cent.[10] The European Community exported 7.4 million tonnes of meal and imported 20 million tonnes, for a net trade deficit of 13.4 million tonnes. Oilseed-meal exports can largely be attributed to increased rapeseed production. This phenomenon deserves special analysis because further increases in rapeseed acreage pose a potential threat.

Rapeseed acreage for the European Community's 10 major protein meals was 1.1 million acres in 1970 and 1.7 million acres in 1980 but increased to 3.1 million acres in 1985. The most dramatic increase was in the United Kingdom, where acreage increased from 12 thousand acres in 1970 to 229 thousand acres in 1980, to 731 thousand acres in 1985. The United Kingdom has now surpassed West Germany as a rapeseed producer. Denmark has also become a major producer, with 420 thousand acres under production in 1985.

Table 5-8

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, European Community, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	6,930	8,215	9,537	10,538	9,833	9,988
Oilseed meals	7,317	13,363	22,538	21,585	22,130	22,596
					(High projection)	
					7,227	9,434
					(25-year trend)	
Production	414	1,125	2,601	5,580	4,423	5,192
					(Low projection)	
					5,580	5,580
Net trade					(25-year trend)	
Oilseeds	–5,431	–7,910	–14,586	–12,000	–16,028	–18,005
Fats and oils	–2,095	–2,457	–1,568	–1,652	–1,529	–1,405
Oilseed meals	–3,553	–6,927	–6,379	–13,438	–12,079	–13,454

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

The five-year average rapeseed yield of 758 kg/acre (1960-64) increased to 1,048 kg/acre (1981-85). The 25-year trend would put yields at 1,159 kg/acre by 1995. Yield levels in both 1984 and 1985 exceeded that level.

The consumption of fats and oils in the European Community has continued to rise. Per-capita consumption was 28.6 kg in 1960, 31.7 kg in 1970, and 35.4 kg in 1980. Future consumption projections for fats and oils were made on the per-capita consumption of 34.5 kg and an estimated income elasticity of 0.053. Projected consumption was 9.8 million tonnes in 1990 and 10 million tonnes in 1995 (see Table 5-8). Both figures are slightly below the actual consumption in 1985, which suggests that the projections based on the 1980-84 period could be low. Protein-meal consumption, which increased sharply in the 1960-80 period, appears to have stabilized over the last few years. Per-capita use was 30.2 kg in 1960, 51.6 kg in 1970, and 83.6 kg in 1980. Based on population and income growth at 2.5 per cent per year, consumption is projected to be 22.1 million tonnes in 1990 and 22.6 million tonnes in 1995. The income elasticity was estimated at 0.087 for the 1980-84 period.

Future oilseed production in the European Community will depend largely upon the changes that may take place in the Common Agricultural Policy (CAP). As stated earlier, the European Community has reached a surplus situation for most agricultural commodities. The European Community, however, is in deficit position for oilseeds, in particular oilseed meals. With the accession of Spain and Portugal and their capacity to produce olive oil, the European Community faces a potential surplus in vegetable oils.

Since 1978 the European Community has attempted to reduce its oilseed deficit by encouraging the production of oilseeds. This was accomplished by inceasing the relative support prices (target prices) for oilseeds in relation to cereal prices. This was begun in 1978 and has led to large increases in rapeseed and sunflowerseed production. This policy has, however, been very costly for the European Community. The problem for the European Community is that oilseeds and protein feedstuffs have duty free access to the market and there is only nominal tariffs on vegetable oils. These duties were bound in GATT in the early 1960s when the CAP was introduced. It means that the European Community has had to make large deficiency payments to encourage production which is handled by paying subsidies to crushers to ensure that domestically produced oilseeds are processed. Since the early 1960s, the European Commission has developed several proposals that would introduce a tax on fats and oils, but each time there has been strong opposition from United States and other oilseed exporters as well as oilseed crushers in the Community.

Faced with mounting budgetary costs to support escalating oilseed production, the Community, in February 1988, has agreed to new provisions in an attempt to restrain production. Guaranteed thresholds have been set for each oilseed with price penalties (co-responsibility levies) to producers if the thresholds are exceeded. An acreage set aside program was also agreed to at the February meeting. It is debatable, however, whether these provisions and their application will be sufficient to constrain oilseed output.

Future oilseed policy in the European Community could depend upon the outcome of the current agricultural policy negotiations under GATT. The European Commission would like to harmonize its oilseeds and protein feedstuffs policy with its cereal policy. It is unlikely that the U.S. would agree to this unless it obtains substantial concessions on price supports. Without going into detail, a harmonized oilseed policy would mean higher internal prices for vegetable oils and protein meals and other feedstuffs in the European Community. The result would be a substitution of domestic cereals for imported and domestically produced oilseed meals in the feed industry. Butter would substitute for margarine in human consumption.

The following is a more detailed examination of the oilseed sector. Table 5-9 outlines the changes in prices for common wheat, barley, rapeseed, and sunflowerseed in three crop years, 1973/74, 1979/80, and 1986/87. Over the 13-year period, 1973 to 1986, intervention prices for wheat increased by 51.54 ECU/tonne, 53.62 ECU for barley, 174.30 ECU for rapeseed, and 285.60 ECU for sunflowerseed.

The more important factor is net returns. A comparison of 1973/74 and 1985/86 gross returns illustrate why EC farms are increasing their rapeseed acreage.[11] In 1973, the expected gross returns in the United Kingdom were 5,562 ECU/hectare for rapeseed compared with 5,589 ECU/hectare for wheat. That was obtained by multiplying the intervention price by the average yield, which is a rough proxy because it does not take into account the actual market price or regional yields. In 1985, gross returns for rapeseed increased to 12,700 ECU/hectare, compared with 11,251 ECU/hectare for wheat. In France and West Germany, the relative changes were more dramatic. In France, gross returns increased from 4,969 ECU to 12,603 ECU/hectare for rapeseed, compared with 5,845 ECU to 10,874 ECU/hectare for wheat. In West Germany, gross returns increased from 5,092 ECU to 12,729 ECU/hectare for rapeseed, compared with 5,692 ECU to 10,927 ECU/hectare

Table 5-9

European Community's Intervention Prices for Common Wheat, Barley, Rapeseed, and Sunflowerseed between Crop Years 1973/74 and 1986/87

	Common wheat	Barley	Rapeseed	Sunflowerseed	Rapeseed/ wheat ratio
			(ECU/tonne)		
1973/74	127.90	166.85	247.20	249.60	1.93
1979/80	149.17	149.17	353.60	385.10	2.37
1986/87	179.44	170.47	421.50	534.70	2.35
1986/87-1973/74	+51.54	+53.62	+174.30	+285.60	
1986/87-1979/80	+30.27	+21.30	+67.90	+149.60	

SOURCE Commission of the European Community, *The Agricultural Situation in the Community*, Luxembourg, Office of Official Publications of the European Communities, selected years.

for wheat. John Nix (1985) estimates a gross margin for rapeseed in the United Kingdom at 560 pounds/hectare, compared with 505 pounds/hectare for winter wheat accepted for milling, 435 pounds/hectare for feed wheat, and 420 pounds/hectare for winter barley accepted for malting. These estimates are for average yields. Under Nix's high-yield scenario, the gross margins further favour rapeseed.

Three levels of projections were made for oilseed production. The 25-year trend fails to capture the rapid increase in oilseed production in recent years. It provides production estimates of 4.4 million tonnes for 1990 and 5.2 million tonnes in 1995. The latter is less than the actual production of 5.6 million tonnes in 1985. A 10-year trend was used to attempt to capture the more recent production increases. Estimates based on the trend during the 10-year period 1976-86 would put 1990 production at 7.3 million tonnes and 1995 production at 9.4 million tonnes – the most likely scenario.

The critical question for Canada is the net trade position for rapeseed and rapeseed products. Table 5-10 outlines the supply/demand relationship for rapeseed for selected periods between 1958 and 1986. In all periods, imports exceeded exports. The data largely reflect the intra-EC trade. To date, the European Community has not been a major competitor for the Canadian rapeseed and rapeseed-meal markets, but that is not the case for canola oil. Table 5-11 outlines the supply/demand situation for rapeseed oil and meal. For rapeseed, it shows that in the period 1978-82, the European Community imported 195 thousand tonnes and exported 449 thousand tonnes of oil, for a net trade surplus of 254 thousand tonnes. That increased to 527 thousand tonnes in 1985. Although the consumption of rapeseed oil is increasing, it is continuing to lag behind oil production. It would seem to reflect the reluctance of European consumers to use canola oil because of the erucic-acid "scare" and the publicity that it attracted in the early 1970s. The European Community has not yet developed a high-yielding, low-glucosinolate variety of winter rapeseed.

When that occurs, some of the resistance to the use of rapeseed meal will disappear. Being a region with a major net deficit, there is no reason for the European Community to be an exporter of rapeseed meal.

Other Western European Countries

With the inclusion of Spain and Portugal in the European Community, the Scandinavian countries of Norway, Sweden, and Finland, along with Switzerland and Austria, comprise the "other Western European countries." Only Sweden is a significant rapeseed producer, and none produces or utilizes much flaxseed. For purposes of consistency and projections, it was decided to include Spain and Portugal in our analysis.

The consumption of fats and oils, and of oilseed meal, is outlined in Table 5-12. Spain dominates this region. It is a major importer of both oilseeds – particularly soybeans – and oilseed meal. Consumers prefer olive oil and sunflower oil to soybean oil. The result is that Spain must export its surplus soybean oil, obtained from soybean crushing. Table 5-12 illustrates the total region's position with regard to its net trade deficit in oilseeds and protein meal. It also shows the increasing net trade surplus in fats and oils.

Projections for the consumption of fats and oil were based on an income elasticity of 0.063 and an income

Table 5-10

European Community's Rapeseed Supply and Demand, Selected Periods, 1958/86

	Five-year average			Crop year
	1958-62	1968-72	1978-82	1985/86*
		(Thousands of hectares)		
Acreage	140	423	724	1,274
		(Tonnes/hectare)		
Yield	1.643	2.473	3.662	2,940
		(Thousands of tonnes)		
Production	230	1,052	2,650	3,747
Imports	146	552	806	1,825
Total supply	376	1,624	3,456	5,572
Demand	278	1,068	1,918	3,758
Exports	49	290	492	1,568
Total use	327	1,358	2,410	5,326

* EC(12).

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years.

Table 5-11

Rapeseed Oil and Meal Disposition, European Community, Selected Periods, 1958/86

	Five-year average			Crop year	
	1958-62	1968-72	1978-82	1982/83	1985/86
			(Thousands of tonnes)		
Rapeseed oil:					
Beginning stocks	11	37	71	102	115
Production	107	434	760	1,049	1,565
Imports	19	92	195	290	440
Total supply	137	563	1,026	1,441	2,120
Domestic use	111	400	496	776	970
Exports	16	124	449	537	967
Total demand	127	524	945	1,313	1,932
Ending stocks	11	40	82	128	183
Rapeseed meal:					
Production	158	595	1,100	1,560	2,221
Imports	126	280	531	437	914
Total supply	384	875	1,631	1,997	3,135
Domestic use	318	650	1,302	1,685	2,447
Exports	66	225	329	312	695
Total demand	384	875	1,631	1,997	3,142

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years.

Table 5-12

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, Other Western European Countries, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	1,472	1,744	1,994	1,757*	2,312	2,386
Oilseed meals	1,055	2,850	5,060	4,962	5,184	5,378
					(High projection)	
					1,604	1,852
					(25-year trend)	
Production	236	474	1,071	1,560	1,604	1,852
					(Low projection)	
					1,560	1,560
Net trade					(25-year trend)	
Oilseeds	–444	–1,933	–4,368	–3,635	–5,236	–6,086
Fats and oils	–144	115	344	473	614	754
Oilseed meals	–441	–735	–844	. .	–1,178	–1,295

* Excluding Portugal.

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

growth of 2.6 per cent per year. Per-capita consumption was estimated at 27.8 kg in 1985 and was projected to increase to 28 kg in 1990 and to 28.2 kg in 1995. Total consumption was projected to increase to 2.3 million tonnes in 1990 and to 2.4 million tonnes in 1995.

The income elasticity for oilseed meals was estimated at 0.103. With consumption of 62 kg per capita in 1985, consumption was forecasted to increase to 5.2 million tonnes by 1990 and to 5.4 million tonnes in 1995. Only Sweden can be considered a major oilseed producer. The 25-year trend would see production rising to 1.9 million tonnes by 1995. It is conceivable, however, that production could remain relatively static at 1,560 thousand tonnes. As a result, the region should experience increasing deficits for both oilseeds and oilseed meal, with an increasing surplus of vegetable oil.

Brazil

Over the last 20 years, Brazil has developed as a major soybean producer and exporter of soybean products. This growth appears to have taken place in particular after 1973, when the United States imposed an oilseed embargo. The embargo coincided with, and was partly a result of, the escalation in the U.S. farm price of soybeans from less than US$3.40/bushel in 1972 to over US$10.00/bushel in June 1973. An analysis carried out[12] as part of the U.S. study on embargo impacts[13] concluded that it was not the embargo, but the rapid rise in soybean prices in 1973, that triggered an increase in production.[14] Furthermore, the fact that "soybean price levels remained high, relative to prior years and to alternative crops, throughout the remainder of the decade"[15] led to further production increases.

The Brazilian government quickly moved to establish a crushing industry rather than export the raw product. One of the objectives was to service the growing domestic market. Differential taxes were used to discriminate against the export of soybeans relative to soymeal. In addition, a wheat support-price program indirectly assisted soybean production, because soybeans were double-cropped with wheat. The main factor was the machinery complementarity.

Table 5-13 shows that oilseed production in Brazil increased from 2 million tonnes in 1960 to 16.2 million tonnes in 1985/86. Soybeans represented 87 per cent; cottonseed, 9.0 per cent; and castorseed, 2 per cent. Part of the increase in production can be attributed to diversification away

Table 5-13

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, Brazil, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	386	759	1,889	2,227	2,627	3,203
Oilseed meals	401	845	3,360	2,520	3,412	4,412
					(High projection)	
					21,527	24,621
					(25-year trend)	
Production	1,951	4,055	16,733	16,232	19,492	22,608
					(Low projection)	
					20,660	22,608
Net trade					(25-year trend)	
Oilseeds	–	351	1,199	3,297	2,314	2,698
Fats and oils	29	130	903	1,079	1,138	1,598
Oilseed meals	120	697	6,757	9,172*	9,782	11,691

* Exports only.

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

from coffee, where the government subsidized farmers to uproot frost-damaged coffee trees. Most of the increased soybean acreage, however, resulted from replacement of food crops in the southern provinces of Rio Grande do Sol, Parana, and Sao Paulo. In more recent years, production has expanded outside those areas. In addition, an aggressive breeding program has developed new varieties, which has helped to increase yields.

What are the prospects for increased production? As in the United States, acreage has stabilized since 1980 at approximately 21.5 million acres. The 20-year trend would put production at 19.5 million tonnes in 1990 and 22.6 million tonnes in 1995. It is quite conceivable that production could exceed the trend, partly because of the need for Brazil to increase its exports. If Brazilian production increased at its most recent 10-year trend (1976-86), production would rise to 24.6 million tonnes by 1995.

Consumption of fats and oil rose by more than 450 per cent between 1960 and 1985 (Table 5-13); it amounted to only 5.9 kg in 1960 and 8.1 kg in 1970 but increased to 15.9 kg in 1980. The income elasticity was estimated at 0.42, and with income assumed to increase at 4.6 per cent per year, per-capita consumption was estimated to increase to 17.6 kg in 1990 and to 19.3 kg by 1995. With population growth, total consumption is projected to reach 2.6 million tonnes by 1990 and 3.2 million tonnes in 1995.

Meal consumption increased by 530 per cent between 1960 and 1985. That was the result of increased livestock production, both for domestic consumption and export. Brazil has become a major exporter of poultry meat. The income elasticity for protein meals was estimated at 0.68. Per-capita meal consumption was estimated to reach 22.9 kg in 1990 and 26.6 kg in 1995.

For fats and oils, and protein meals, these forecasts projected a much lower growth rate than that experienced by Brazil up to 1985/86. This suggests that the forecasts may have erred on the low side.

The net trade in oilseeds and products has been outlined in Table 5-13. As discussed earlier, it illustrates that the main growth has been in meal exports. Brazil's share of the world's soybean trade is 6.5 per cent (the average from 1980 to 1985), compared with the U.S. share of 79.5 per cent for the same period. Brazil captured 37.8 per cent of the world's trade in soybean meal. The U.S. share, which was over 65 per cent in 1965, fell to 28.3 per cent. Similarly, Brazil's share of the world's trade in soybean oil rose to 26.1 per cent (from 1980 to 1985), compared with 24.8 per cent for the United States. In 1965, the United States had 78 per cent of the world's soybean-oil trade. Other countries, particularly Argentina, have also captured an increasing share of that trade.

Using the 25-year trend, Brazil's exports of soybean meal would rise to 11,690 million tonnes by 1995. Using a 75-per-cent extraction rate for oilseeds produced in Brazil, the production of 22.6 million tonnes, which is the 25-year trend, would result in approximately 17.6 million tonnes of soybean meal being produced. Since domestic consumption and exports account for 16.1 million tonnes, it would be feasible for Brazil to expand its exports. Similarly, it would also be feasible for Brazil to meet its domestic soybean-oil requirements and to reach its 25-year trend in soybean-oil exports.

Soviet Union

Considering its size and its stage of development, the Soviet Union lags well behind other developed economies as a user of both oils and fats and protein meals. Per-capita consumption of oils and fats amounted to only 13.7 kg in 1960 and 20.2 kg in 1980. The income elasticity for 1984 was estimated at 0.085. Although relatively high compared with an income elasticity of 0.053 for the European Community, it does not result in any significant increase in per-capita consumption, which is projected to rise to 22.3 kg by 1995. As a result, the total consumption of oils and fats is projected to reach 6.7 million tonnes by 1995. That is quite possibly an underestimation.

Protein-meal consumption per capita was only 9.9 kg in 1960, but it increased sharply to 21.0 kg in 1980. The income elasticity was estimated at 0.138. With income assumed to grow at 1.65 per cent per year, the consumption of meal is projected to increase to 6.7 million tonnes in 1990 and to 7 million tonnes in 1995. That would mean usage of only 23.5 kg per capita in 1995, compared with 69.6 kg in Canada and 81.1 kg in the European Community. Again, these projections could conceivably underestimate usage in the Soviet Union.

The key to future usage of oils and fats, and particularly meal, in the Soviet Union is production. That country is a major producer of wheat and feed grains, not a major producer of oilseeds. Oilseed production amounted to only 10.6 million tonnes in 1985. It appears that the Soviet Union is reluctant to increase its imports of oilseeds and oilseed

Table 5-14

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, Soviet Union, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	2,923	4,299	5,369	6,229	6,359	6,682
Oilseed meals	2,113	4,073	5,561	6,298	6,657	7,027
					(High projection)	
					12,779	13,836
					(25-year trend)	
Production	6,929	11,055	10,897	10,620	11,827	12,250
					(Low projection)	
					11,827	11,827
Net trade					(25-year trend)	
Oilseeds	–276	140	–1,157	–1,094	–1,771	–2,131
Fats and oils	110	440	–581	–610	–871	–1,132
Oilseed meals	492	–33	–413	. .	–1,013	–1,295

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

products to permit a further increase in human per-capita consumption of vegetable oils or in protein meals to support a growing livestock population. Meat production in the Soviet Union remains at approximately one-half the per-capita levels of North America, and well below the rest of Europe.

Based on the 25-year trend, oilseed production in the Soviet Union is projected to rise to 11.8 million tonnes in 1990 and to 12.3 million tonnes by 1995. Based on sharply increased rapeseed acreage in 1986 and 1987, it appears that the Soviet Union is attempting to expand rapeseed production. Given its temperate climate, similar to that of Northern Europe and Canada, high production of rapeseed should be feasible.

Should the Soviet Union be able to achieve twice the trend level, it would still only result in the production of 13.8 million tonnes. That, however, would enable it to meet its projected requirements of 7 million tonnes of meal without significantly increasing imports.

Japan

As discussed earlier, Japan is a very important market for Canada and could have a strong influence on the Canadian canola/rapeseed economy.

Japanese consumption of fats and oil was extremely low in 1960, at only 7.0 kg per capita, or a total consumption of 654 thousand tonnes. Per-capita use doubled to 15.5 kg in 1980. Income elasticity was estimated at 0.041; per-capita consumption, at 16.7 kg in 1985. Total consumption of fats and oil was projected at 2.1 million tonnes for both 1990 and 1995. That would suggest that the Japanese diet has reached a level of saturation for fats and oils.

In contrast to its demand for fats and oil, the demand for oilseed meal is projected to increase. As Japanese income expanded, meat consumption increased strongly. The production of meat required large increases in protein meals. Usage per capita increased from 13.8 kg in 1960 to 33.1 kg in 1970, and still further to 40 kg in 1980. Income elasticity for meal was estimated at 0.067. Per-capita consumption was estimated to increase to 44 kg by 1995. Total usage of meal was projected to increase to 5.4 million tonnes in 1990 and to 5.5 million tonnes in 1995.

Historically, the Japanese depended on rapeseed for their edible vegetable-oil supply. In the last 25 years, rapeseed production has continued to decline, reaching an insignificantly small level. Japan is thus almost totally dependent upon imports for its supplies of vegetable oil and meal. It is also noteworthy that Japan has followed a policy of developing its domestic crushing industry rather than importing processed vegetable oils and meals. As explained earlier,

Table 5-15

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, Japan, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	654	1,369	1,811	2,227	2,084	2,146
Oilseed meals	1,280	3,444	4,672	5,095	5,350	5,542
					(25-year trend)	
Production	778	243	217	135	–	–
Net trade					(25-year trend)	
Oilseeds	–1,523	–4,398	–5,905	–6,657	–7,780	–8,803
Fats and oils	–173	–289	–237	–1,411	–105	–70
Oilseed meals	–14	–292	–431	. .	–433	–489

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

that has created certain problems for the Canadian crushing industry.

Assuming that the projections of a higher demand for meal relative to fats and oils are correct, it is likely that Japan's increased oilseed imports will consist of soybeans rather than canola/rapeseed. In other words, Japan is likely to prefer the higher meal content of soybeans to the lower meal content of canola/rapeseed.

China

China, with its population of one billion plus, and its recent surge in economic growth, provides the greatest uncertainty for the world's oilseed economy. The Chinese diet has been highly dependent upon cereals and vegetables. Consumption of fats and oils has been relatively low. Although meat consumption is low by OECD standards, it is high by Asian and developing-country standards. It is estimated at 16 kg per capita.[16] This is largely explained by the fact that China has 50 per cent of the world's hog population. Pork production, however, continues to be based on household production, with low levels of feed-grain and protein-meal usage. In 1960, consumption of fats and oils amounted to only 2.5 kg; it remained at that level in 1970 but is estimated to have grown to 3.9 kg by 1980. Consumption of meal was estimated at 5.5 kg in 1960, to have actually declined to 4.1 kg by 1970, and to have risen to 6.7 kg in 1980.

Total consumption of fats and oils is shown in Table 5-16 to have increased from 3.8 million tonnes in 1980 to 6.9 million tonnes by 1985. That growth resulted in an income-elasticity estimate of 1.37, meaning that fats and oils are a superior good in China. With incomes assumed to grow at 4.5 per cent, per-capita consumption was projected to increase to 8.4 kg in 1990 and to 11.3 kg by 1995. That would result in a doubling of China's consumption of fats and oils by 1995 to 13.3 million tonnes.

Even more significant are the projected increases for protein meals. Income elasticity was estimated at 2.24, reflecting a large demand for meat and hence protein meal. This very high elasticity resulted in a projection for the per-capita consumption of meal to increase to 18 kg in 1990 and to 29.1 in 1995. In some respects this would parallel what has taken place in Japan, where meat consumption increased 20 kg per capita between 1960 and 1970. That would result in a projected requirement of 19.9 million tonnes of meal by 1990 and 34.2 million tonnes by 1995. It would make China the world's largest user of meal, ac-

Table 5-16

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, China, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
			(Thousands of tonnes)			
Consumption						
Fats and oils	1,611	2,104	3,822	6,856	9,267	13,299
Oilseed meals	3,577	3,457	6,500	10,429	19,907	34,193
					(High projection)	
					29,114	34,828
					(25-year trend)	
Production	12,701	13,936	19,254	29,570	23,972	26,258
					(Low projection)	
					23,972	26,258
Net trade					(25-year trend)	
Oilseeds	1,066	461	–352	1,310	141	69
Fats and oils	119	29	–321	–203	–261	–319
Oilseed meals	12	34	31	. .	54	62

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

counting for approximately 25 per cent of total world usage. Is that likely? It would suggest a major change in Chinese meat-production technology, from simple household production to large-scale production, using manufactured feedstuffs. That, in turn, would trigger an increased demand for feed grains and protein meals.

As with the Soviet Union, the growth in demand for oils and meal is likely to be mainly the result of increased production. As with wheat, China has achieved a remarkable increase. Oilseed production increased by 53 per cent in the five-year period 1980-85 (see Table 5-16). The 25-year trend places production in 1995 at only 26.3 million tonnes – well below the actual level in 1985. It might be more realistic to assume that China could increase production at twice the 25-year trend. The low-production scenario suggests that production in China is unlikely to be below its 25-year trend; that would be an actual decline in production from recent years and would place production at 34.8 million tonnes by 1995. Even with that high a projection, however, China would fall far short of the projected demand for both fats and oils, and protein meal. For example, assuming an average extraction ratio of 75 per cent meal to 22 per cent oil would provide only 26.1 million tonnes of meal and 7.6 million tonnes of vegetable oil. That would leave the meal account 8 million tonnes in deficit. Is it likely that China would resort to that level of imports to meet its protein-meal requirements? To date, China has not shown a willingness to import oilseeds or oilseed products. This suggests that surplus-producing oilseed countries like the United States, Brazil, Austria, and Canada may find a new market for their oilseeds, and possibly their oilseed products.

India

India, with the world's second largest population, is – like China – a large potential market for agricultural products. At present it is relatively self-sufficient. Unlike China, which has managed to slow its population growth, however, India's population is increasing at a rate of 20 million per year and should catch up to China sometime after 2000. When the entire Indian Subcontinent is taken into account (Pakistan and Bangladesh), the population approximates that of China today.

India's consumption of fats and oils exceeds that of China, having amounted to 6.6 kg in 1980, compared with China's 3.9 kg. Income elasticity was estimated at 1.73 for 1984. With income projected to increase at 1.7 per cent per year, consumption of fats and oils was estimated to increase

Table 5-17

Actual and Projected Consumption, Production, and Trade – Oilseeds, Fats and Oils, and Oilseed Meals, India, 1960-95

	Actual				Projected	
	1960	1970	1980	1985	1990	1995
	(Thousands of tonnes)					
Consumption						
Fats and oils	2,525	3,028	4,410	5,509	7,168	9,084
Oilseed meals	2,943	3,062	3,359	5,143	7,504	10,345
					(High projection)	
					14,299	16,343
					(25-year trend)	
Production	7,898	9,696	9,856	12,910	12,459	13,277
					(Low projection)	
					12,766	13,277
Net trade					(25-year trend)	
Oilseeds	–70	10	–3	19	50	66
Fats and oils	22	–180	–1,358	–1,332	–1,663	–1,994
Oilseed meals	447	912	746	..	1,113	1,175

SOURCE S. Mielke, *Oil World*, Hamburg: ISTA Mielke GmbH, West Germany, selected years, 1960-85; and authors' projections for 1990 and 1995.

to 9.8 kg per capita by 1995; with population projected to increase to 927 million, total consumption is projected to increase to 9 million tonnes by 1995.

India's meat consumption per capita is placed at 1 kg per year,[17] compared with 10 kg in Pakistan, 0.5 kg in Bangladesh, and 16 kg in China. Income elasticity was estimated at 2.82; usage of meal per capita, at 6.9 kg in 1985. Per-capita consumption is projected to reach 11.2 kg in 1995. Total requirements of meal are projected to reach 7.5 million tonnes in 1990 and 10.3 million tonnes by 1995. That is well below the projections for China, but at present India does not have the basis of a meat diet.

Oilseed production has increased significantly, primarily in the last five years. The 25-year trend would place production at 13.3 million tonnes by 1995; however, it already reached 12.9 million tonnes in 1985. A more likely estimate is that India will be able to double its 25-year trend, which would put production at 16.3 million tonnes by 1995.

India's oilseed production of 12,910 thousand tonnes in 1984/85 consisted of cottonseed (2.7 million tonnes), groundnuts (4.7 million tonnes), rapeseed (2.7 million tonnes), soybeans (700 thousand tonnes), linseed (430 thousand tonnes), and others (1.8 million tonnes). The weighted-average rate of oil extraction would be approximately 31 per cent; that of meal, 47 per cent. Assuming a similar distribution of production, 16.3 million tonnes of oilseeds would yield 5.1 million tonnes of vegetable oils and 7.7 million tonnes of oilseed meal. Since butterfat production is relatively low, at 752 thousand tonnes (1984/85), it is possible that India could be moving towards a deficit position in both fats and oils, and oilseed meal. The trade data indicate that India has increasingly become a net importer of vegetable oils, particularly soybean oil, rapeseed oil, and palm oil.

To date, India has tended not to import oilseeds, preferring instead to import the processed oil. That may suggest a scarcity of capital to expand its crushing capacity. The 25-year trend suggests that India may increasingly become an exporter of oilseed meals. Although India has been a net exporter in the past, that possibility can likely be discounted.

India, given reasonable economic growth and its inability to slow its population growth, could become a major market for oilseed products – particularly fats and oils. As explained earlier, India has become Canada's number one market for canola oil.

World Production and Consumption: A Summary

World consumption of fats and oils is projected to reach 75 million tonnes in 1990 and 87.4 million tonnes in 1995. That constitutes a rate of increase of 3 per cent per year, compared with the average rate of increase of 4.7 per cent between 1970 and 1985. It largely reflects the projections of no growth in per-capita usage in the developed economies. If that is incorrect and increased per-capita use should develop, those projections would underestimate world usage.

The world's use of protein meal is projected to reach 116.8 million tonnes in 1990 and 199.5 million tonnes in 1995. That represents a growth rate of 3.8 per cent per year, compared with the growth rate of 7.7 per cent between 1970 and 1985. Similarly, it reflects a very modest growth in the use of protein meal in the developed economies. The largest growth was forecasted for the large-population developing economies, such as China and India. It assumes that meat consumption per capita is unlikely to rise in the developed economies but that it will increase significantly in the developing economies.

The projections of oilseed production were based on a combination of trends. The methodology is relatively simplistic. It assumes that the developments that have taken place in the past provide the best estimate for the future. We realize that this is not always the case; nor does this approach pick up major changes in key factors that could result in "turning points." No attempt was made to determine if the projections are feasible in terms of available acreage and/or yield increases.

Comparisons can be made with other estimates. *Oil World*, in 1983, made projections for the production and consumption of oilseeds and oilseed products until the period 2003 to 2007. It was projected that the world's 10 major oilseed crops would produce 223 million tonnes for the period 1992/93 to 1996/97. That closely matches the study's projection of 227.0 million tonnes for 1995, based on a 25-year trend.

Oil World estimated world consumption for the 17 major fats and oils to be 84.1 million tonnes for the period 1993-97. That compares favourably with this study's projection of 87.4 million tonnes for 1995. The closeness of these two forecasts is important because of the different methodologies used.

Oil World estimated that consumption of the 10 major oilseed meals would equal 132.5 million tonnes for

1993-97. This study's estimate was only 4.5 per cent higher, at 138.4 million tonnes.

Although the totals were similar, there were greater differences in the country and regional projections.

6 Summary and Conclusions

Canada is a net exporter of wheat, coarse grains, and oilseeds. The large land base and the efficient and advanced technology adopted by Canadian farmers has enabled Canada to be a major player in the wheat and canola/rapeseed export markets. The Canadian domestic market is small; thus our exportable surplus relative to annual production is large. This makes the Canadian grain economy sensitive to changes in world market conditions.

The future of the Prairie grain economy depends upon future developments in the world markets for wheat, coarse grains, and oilseeds. These crops are produced and consumed in almost every country of the world. The largest producers are China, the European Community, the Soviet Union, the United States, and Canada; the largest consumers are China, India, and Pakistan, which collectively represent over 50 per cent of the world's population. The most influential player in the world's grain market is the United States. The future volume of trade in agricultural commodities depends upon future changes in consumption and production balances in the major producing and consuming countries.

The price received by Canadian farmers depends upon the export price and upon federal government policy. The export price of Prairie grains is determined by world supply and demand conditions, as well as by government policy. World demand conditions are determined by population and income growth; the price of the product has little impact on consumption levels – i.e., the demand curves are highly inelastic. World supply conditions are a function of weather, technology, and government policy (price supports to farmers such as exist in the European Community).

The forecasts presented in Chapter 3 for the wheat sector suggest that the price will not improve until the early 1990s. These forecasts were based on existing government policy and average weather conditions. If either of those change, the forecasts will be in error. For example, a drought in a major importing country could reduce the stocks faster than anticipated, resulting in a price rise sooner than predicted. Another possible limitation on the accuracy of this forecast is the use of the Export Enhancement Program in the United States. As of spring 1988, the United States was continuing to lower its stocks of wheat because of the drought experienced in importing regions during the 1987 crop year and the use of the EEP. That will cause the price of wheat to increase sooner than predicted in the analysis. The price received by Canadian farmers is determined by the U.S. Farm Bill (loan rate) and the world stock/use ratio. The price of wheat is expected to rise as the stock/use ratio falls to 20 per cent or lower. The U.S. loan rate represents the floor price for wheat, except in periods of shortages (i.e., the low stock/use ratio).

The composition of wheat exports is likely to change in the future. The increased demand for feed wheat will translate into a growing market for lower-quality wheats (i.e., high-yield varieties). The market for high-quality wheat will remain a premium market for Canada; however, the level of the premium will depend on the supply of high-protein wheats. The growth in the wheat market will be in feed wheats rather than in bread wheats.

In summary, the future of the grain economy of the Prairies is as much dependent on government policy as on anything else. Canadian grain farmers are not only affected by Canadian government policy but by the policies of foreign governments as well. The most influential governments in the export markets are the United States and the European Community. Canadian grain farmers face an uncertain future because of lack of knowledge or control of these major forces in the grain markets of the world.

The coarse-grains market is dominated by the United States, which is the largest producer and trader of corn. The current level of coarse-grain stocks in the world is 26 per cent of total consumption, and this should decline to approximately 16 per cent before prices can be expected to increase significantly. The U.S. loan rate for corn is the world's floor price, except when the United States uses the Export Enhancement Program. Canadian barley and feed-wheat prices are linked to the U.S. corn prices (adjusted for nutritional value) and spot shortages.

The production of corn is expected to increase significantly in China and in the European Community. In the United States, we expect production to be around 237 million tonnes by 1995. This represents a significant decline from the 1985 level of 274 million tonnes. As the United States holds most of the coarse-grain stocks, the acreage set aside will remain so until stocks are reduced and corn prices increase.

World consumption of coarse grains is expected to be 962 million tonnes by 1995, with most of the increase occurring in China. The potential growth in meat consumption in China is large, but it is impossible to be certain how much of that potential will be realized. Here, the forecasts are based upon the assumption that China will constrain the import of coarse grains (some of which may be used for animal feed) and, instead, increase wheat imports.

The price of coarse grains is expected to start rising by 1991/92. By 1990, the coarse-grains stock/use ratio is projected to decline to around 18 per cent, and prices will start to show some strength in the market. If China does not increase production as rapidly as we forecast or if it decides to import coarse grains, the prices could respond sooner than 1990.

The future consumption and production of canola/rapeseed and flaxseed are projected to increase on trend until 1995. Again, the major player in the edible-oilseed market is the United States, with Canada, Brazil, and India playing much smaller roles. The flaxseed market is more concentrated in Canada, United States, and Argentina.

The production of oilseeds is expected to increase, over past trend, to 227 million tonnes by 1995. This increase will occur mostly in the United States. Canadian production of oilseeds is predicted to be 5.4 million tonnes by 1995. The consumption of oilseeds is expected to increase to 87 million tonnes of fats and oils and 138 million tonnes of oilseed meal. The trade in oilseeds will increase, and the European Community and Japan are expected to be the major importers.

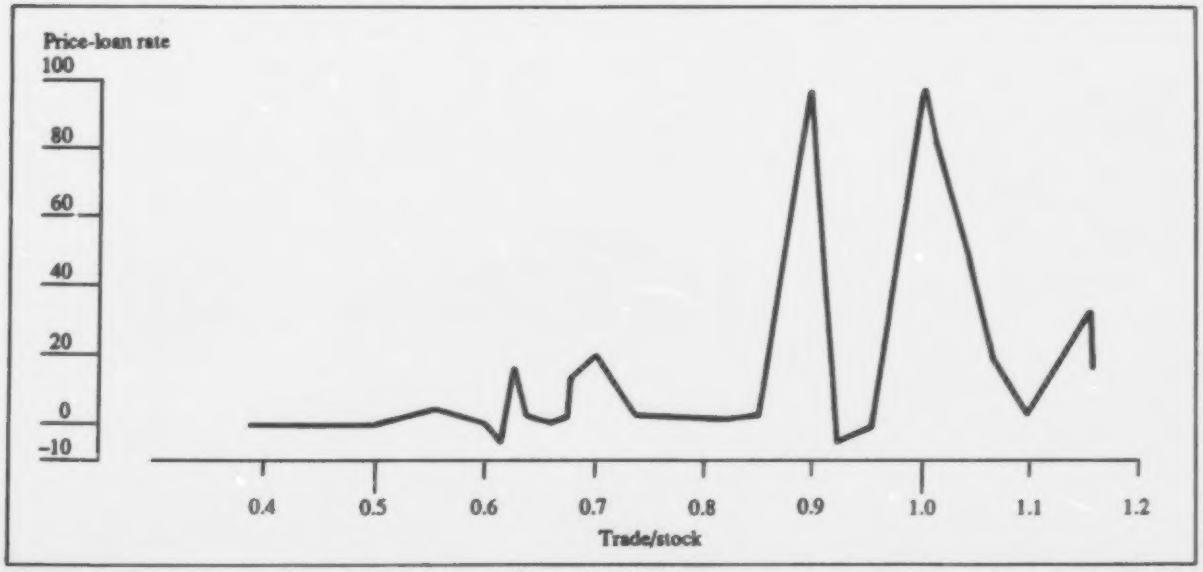
Instability in Prices and Forecasting

The instability in prices appears to be related to the level of world trade compared with stock levels. As the quantity of a traded commodity approaches the stock levels, the fluctuations in price become much larger. This is shown for wheat in Chart 6-1. The volume of wheat traded in 1987/88 is approaching the quantity currently held in stock. If production were to drop 15 to 20 million tonnes in 1988, we would expect the wheat price to increase significantly. The 15 to 20 million tonnes would be less than the annual production of wheat in Canada.

The stocks of grain represent a measure of food security. Once the quantity of stock traded equals the quantity held,

Chart 6-1

Wheat: Trade-Stock and Price-Loan Rate Relationship, 1961-86



SOURCE U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

any small change in supply (production) would cause prices to increase. The market then sits on a knife's edge and prices are unstable, as shown in Chart 6-1. It is impossible to forecast price movements in any market other than the Futures Market.[1] When the volume of trade is smaller than that of stocks, prices stay close to the loan rate, and it is possible to forecast their magnitude. In 1987 the wheat/stock ratio was approximately 0.75 and getting larger, indicating that prices will become more unstable in the future.

Performance of Past Forecasts

Price Forecasts by Agriculture Canada

In the mid-1970s, the Canadian government was very bullish on future grain prices. It appeared to Agriculture Canada's analysts that prices would continue to increase well into the future, as shown in Table 6-1. These forecasts, used by Agriculture Canada, were in error by a minimum of $4.00/bushel for wheat and $3.00/bushel for barley. The reasons for the errors included: 1) changes in the U.S. farm policy that totally altered the grain market; and 2) the supply response to higher grain prices in the mid-1970s. The analysts forgot that producers respond to higher prices by increasing supply. In addition, changes in macroeconomic variables, such as monetary policy, affected the grain prices. These forecasts were used in Agriculture Canada's policy analysis, causing the policies to appear more economically plausible than was actually the case – questioning, for example, the actual soundness of the WGSA.

Price Forecasts by Agencies outside Canada

The Food and Agriculture Organization of the United Nations, in its *Agricultural Commodities-Projections for 1975 and 1985*, forecasted the production and consumption of world wheat and coarse grains to 1975. Their consumption projections, like ours, were based on projected population and income growth rates. In order to obtain production projections, the FAO had projected the area planted and yields to 1975. The FAO projections, as well as the actual production and consumption levels experienced in 1975, are reported in Table 6-2.

The FAO model underestimated the world's wheat production for 1975 by 53 million tonnes in the low-production scenario; 45 million tonnes of the difference originated with production forecasts for the United States, China, and the Soviet Union, as well as for India and Pakistan. In all countries except the United States, they significantly underestimated the yields; in the United States, they underestimated the acreage in production. (Table 6-3 provides detailed information on the low-production estimate.) The FAO model underestimated the U.S. wheat area, the reason

Table 6-1

Past Price Forecasts[1] for Wheat and Barley, 1979-87

	Canadian Wheat Board's pool price								
	1979	1980	1981	1982	1983	1984	1985	1986	1987
	($/bushel)								
Wheat (1CWRS)*									
Low	3.10	3.18	3.25	3.95	4.19	4.44	4.70	4.97	5.29
Medium	4.50	5.25	4.76	5.50	5.83	6.18	6.55	6.94	7.36
High	5.19	6.65	6.25	7.05	7.47	7.92	8.40	8.91	9.43
Barley (Winnipeg No. 1 Feed T.B.)†									
Low	1.80	2.45	2.10	2.50	2.65	2.81	2.98	3.16	3.34
Medium	2.30	2.95	2.70	3.15	3.34	3.54	3.75	3.98	4.21
High	2.80	3.45	3.30	3.80	4.03	4.27	4.52	4.80	5.08

* Canadian Western Red Spring.

† Winnipeg No. 1 Feed Thunder Bay.

1 By Agriculture Canada.

SOURCE David R. Harvey, *Christmas Turkey or Prairie Vulture? An Economic Analysis of the Crow's Nest Pass Grain Rates*, Institute for Research on Public Policy (Montreal: IRPP, 1980).

being the difficulty in forecasting government policies. The introduction of deficiency payments in 1974 had a dramatic impact on the area planted to wheat; consequently, it exceeded the projected area by more than 10 million hectares, and the United States produced 13 million tonnes more wheat than the FAO model predicted.

The FAO model underestimated China's yields of wheat. In the period 1957-65, the average annual growth rate of grain yields was 1.3 per cent. In the following 10 years (during the cultural revolution), the average annual growth rate in grain yields rose to 3.4 per cent.[2] The FAO model was unable to predict the shift in policies and priorities in China that were revealed with the "cultural revolution." The same phenomenon was observed in the production projections for the Soviet Union. The projected wheat yields in the Soviet Union were slightly lower than the average yield experienced in 1975, and because of the size of the area planted, this translates into 7 million tonnes of deviation in production forecasts.

Even though yield and area were projected separately, the FAO model also failed to project technological change. A good example of this, as shown in Table 6-3, is the case of India and Pakistan. In the late 1960s and early 1970s, those countries adopted high-yielding wheat and rice technologies, and the yields rose tremendously. Since the FAO projections were based on past trends, they could not capture the impact of technological change that was about to be adopted in the near future.

On projecting the world production of coarse grains to 1975, the FAO model did a very good job. The model predicted that world production would be between 640 and 664 million tonnes; the actual production in 1975 was 646 million tonnes. World consumption of coarse grains was projected very accurately as well. The FAO model predicted the world consumption of coarse grains to be between 645 and 668 million tonnes; the actual consumption in 1975 was 645 million tonnes.

The FAO model underestimated wheat consumption to 1975 by 60 to 63 million tonnes. The reasons for that error are various, and it is difficult to point out what went wrong with their projections. Underestimating the growth rates of GDP per capita and/or population rates, and/or income elasticities of demand for wheat in different countries, could cause that type of error; however, it is more likely that the FAO underestimated the income elasticity of demand for wheat. The other parameters of consumption estimates (income, and population growth rates) were used in forecasting the world consumption of coarse grains as well and did not cause any deviation in projected volume from the actual 1975 consumption.

Overall, the production and consumption of wheat seem to be more sensitive to policy changes than are those of coarse grains. The projections presented in this report carry all of these errors, perhaps at different proportions, for a very obvious reason: there is no possible way to forecast government policies. We tried to cover different production

Table 6-2

Comparison of Past Wheat-Production Projections to 1975[1] with That Year's Actual Production

	Wheat production			Coarse-grain production		
	Projected			Projected		
	Low	High	Actual	Low	High	Actual
			(Millions of tonnes)			
United States	44.7	44.7	57.9	184.5	184.5	185.4
Canada	18.8	18.8	17.1	16.8	16.8	20.0
Soviet Union	59.6	64.4	66.2	67.5	72.0	66.6
China	30.3	31.8	45.3	86.1	90.8	64.5
India and Pakistan	21.9	32.0	31.9	30.6	34.9	31.4
World	303.5	326.7	356.6	640.5	664.3	646.0

[1] By the Food and Agriculture Organization of the United Nations.

SOURCE Food and Agriculture Organization of the United Nations, *Agricultural Commodities – Projections for 1975 and 1985* (Rome: FAO, 1967), and *FAO Production Yearbook*, various issues; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, various issues.

Table 6-3

Past Low-Assumption Projections of Wheat-Production Areas and Yields for 1975,[1] Selected Countries

		Area	Yield	Production
		(Millions of hectares)	(Tonnes/ha)	(Millions of tonnes)
United States	Projected	18.9	2.36	44.7
	Actual	28.1	2.10	57.9
China	Projected	30.0	1.00	30.0
	Actual	27.6	1.60	45.0
Soviet Union	Projected	64.4	0.93	59.6
	Actual	62.0	1.07	66.2
India and Pakistan	Projected	23.2	0.94	21.9
	Actual	23.8	1.33	31.9

1 By the Food and Agriculture Organization of the United Nations.

SOURCE Food and Agriculture Organization of the United Nations, *Agricultural Commodities – Projections for 1975 and 1985* (Rome: FAO, 1967), and *FAO Production Yearbook*, various issues; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, various issues.

scenarios reflecting different policy actions, at least on the part of the major wheat-producing countries; yet we have left at least that many policy options out. In our analysis, some notion of technological change in China's production of coarse grains was introduced, which may, or may not, occur in the future. The real test of these findings will be the actual consumption and production levels that will be observed in the future.

W. H. Meyers, in his Ph.D. dissertation,[3] predicted the consumption of wheat and coarse grains to 1985 and 1995. He adopted a simultaneous equation model, and his results are summarized in Table 6-4. In model (a), Meyers keeps the prices constant at their 1974/75 levels; in model (b), he assumes that production will grow by 3.1 per cent per annum and that 18 per cent of production will be held in stocks. Model (b) predicts that the U.S. price (f.o.b. Gulf) of #2 HWO wheat, deflated by the CPI, would be $84.90/tonne in 1985; that translates into a nominal price of $108/tonne. Model (b) projects world consumption more accurately and suggests that the world consumption of grain increases at almost a constant rate.

Comparison of Production and Consumption Projections to 1990 and 1995

Wheat — The results of different studies regarding the world's grain production, consumption, and trade are summarized in Table 6-5. These results are very sensitive to the choice of base year. The International Wheat Council (IWC) and Michigan State University (MSU) projections both have the same base year, and even though they adopted different forecasting models, they have produced very similar results.

The projected production and consumption figures for 1990 are very close to each other; yet they produce a set of

Table 6-4

Past Projections of Wheat and Coarse-Grain Consumption to 1985[1]

Wheat consumption		Coarse-grain consumption	
Actual	Projected	Actual	Projected
(Millions of tonnes)			
487.6	434.4 (a)	770.6	823.4 (a)
	466.2 (b)		796.3 (b)

1 By W. H. Meyers (see source below). For an explanation of models (a) and (b), see accompanying text.

SOURCE W. H. Meyers, "Long-run income growth and world grain demand: An econometric analysis," unpublished Ph.D. dissertation, University of Minnesota, 1977; and U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-9-87, August 1987.

trade estimates that are significantly higher than ours. The reason for this may be the distribution of production and consumption among countries; apparently our projections assume that production will not grow significantly in the five major producing countries and that it will stay on trend in the rest of the world (which happens to be the net wheat importer). The impact of this approach is a decline in trade volume.

Somehow projections appear to be pessimistic next to the EIU projections; this is also a function of the base year. The base year in MSU and IWC projections (1980) was in the middle of a period of expanding trade, and this was reflected in their results. In 1985, our base year, world trade in wheat fell to 84.6 million tonnes, which was lower than its 1979 level.

Meyers, in the study quoted in the previous section, also projected wheat consumption to 1990 and 1995. His projections were 481 to 529 million tonnes for 1990 and 536 to 599 million tonnes for 1995. Another study that was not reported in Table 6-4 contains the FAPRI projections. The FAPRI had projected world trade in wheat to 1990, and their forecasts range between 92 and 96 million tonnes.

Coarse Grains — The basic difference between the forecasting models reported in Table 6-6 is the growth rate in production, consumption, and trade. Both the IWC and

Table 6-5

Wheat: Comparison of Production, Consumption, and Trade Projections to 1995

	Projections by:			
	Authors	IWC[1]	MSU[2]	EIU[3]
	(Millions of tonnes)			
Production				
1985 (base year)[4]	499	493	492	---
1990	543	549	549	---
1991	549	---	---	546
1995	572	613	612	---
Consumption				
1985 (base year)[4]	487	499	498	---
1990	542	554	550	---
1991	553	---	---	548
1995	606	615	607	---
Trade				
1985 (base year)[4]	85	99	84	---
1990	85	104	100	---
1991	92	---	---	87
1995	127	109	119	---

[1] IWC – International Wheat Council. The IWC uses 1980 as the base year and reports projections for the year 2000; projections for the other years were computed by using the average annual growth rates reported by the IWC.

[2] MSU – Michigan State University. The MSU model also uses 1980 as the base year and reports projections for 1990; growth rates have been used to obtain the projections to 1995.

[3] EIU – Economist Intelligence Unit. The EIU model uses 1985 as the base year, as does the authors' model.

[4] Base year (1985) figures are actual USDA figures.

SOURCE International Wheat Council, "Long-term grain outlook," Secretariat Paper No. 14, 1983; Michigan State University, "Long-term forecasts," Department of Agricultural Economics, 1982; and R. Woodhams, "Wheat to 1991: Adapting to oversupply," *The Economist Intelligence Unit*, Special Report 1070 (London: The Economist Publication Ltd., 1986). Authors' estimates based on data from U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987; Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues; and International Wheat Council, *World Wheat Statistics*, selected years.

Table 6-6

Coarse Grains: Comparison of Production, Consumption, and Trade Projections to 1995

	Projections by:		
	Authors	IWC[1]	MSU[2]
	(Millions of tonnes)		
Production			
1985 (base year)[3]	846	816	826
1990	836	892	930
1995	943	975	1,047
Consumption			
1985 (base year)[3]	802	806	835
1990	863	886	935
1995	962	973	1,048
Trade			
1985 (base year)[3]	83	111	110
1990	78	120	135
1995	94	129	166

1 IWC – International Wheat Commission. The IWC uses 1980 as the base year and reports projections for the year 2000; projections for the other years were computed by using the average annual growth rates reported by the IWC.

2 MSU – Michigan State University. The MSU model also uses 1980 as the base year and reports projections for 1990; growth rates have been used to obtain the projections to 1995.

3 Base year (1985) figures are actual USDA figures.

SOURCE International Wheat Council, "Long-term grain outlook," Secretariat Paper No. 14, 1983; and Michigan State University, "Long-term forecasts," Department of Agricultural Economics, 1982. Authors' estimates based on data from U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987; and Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues.

MSU models imply continuous growth in all three. In the IWC model, the production and consumption of coarse grains increase by 1.9 per cent per annum; trade, by 1.5 per cent. In the MSU model, the rates are 2.4 per cent for production, 2.3 per cent for consumption, and 4.2 per cent for trade. Our model, in response to growing world stocks, projects a stagnation in the production of coarse grains until 1992. Consumption, on the other hand, grows mainly as a function of income and population growth. Production cuts and consumption growth do not occur in the same place, however, and this gives rise to a decline in trade volume until 1992. The supply of oilseeds and wheat is currently short, causing the prices to increase; however, under normal weather conditions, the supply would be larger.

The income elasticities for bread are low, although still positive, in developing countries. As population increases, the consumption of wheat will continue to increase. The one exception to this is China, where incomes may increase rapidly in the future; and given their population, total consumption could rise rapidly. The constraint to consumption in China may well be their lack of a physical infrastructure to handle large volumes of grain. The demand for coarse grains is linked to the demand for meats. This demand is growing rapidly in the Pacific Rim and represents a significant potential market in the future. Corn is the major coarse grain; however, barley and wheat can compete in that market, especially in the production of poultry. Canada needs to position itself to service this growing world market.

The demand for oilseeds and oilseed products is the most optimistic for all grain commodities. Canola is a superior oilseed, and the world supply/demand balance of oilseeds will favour strong prices in the future. Given the ability of our producers to grow this crop, it is likely that canola will become a more important crop in the future.

In terms of the future of the Prairie grains economy, policies set in the United States are key. Because of the very large acreages and trade of grains in the United States, they are the dominant force. Before any forecasts can be made regarding world grain prices, one must forecast U.S. government policy.

Survival of the EC's Common Agricultural Policy is not in question for the foreseeable future, although one possible result of the current trade war is that the European Community could start imposing quotas on cereals production. The European Community will continue to import high-quality wheat, with the amount depending on the weather. They will remain major exporters of wheat.

Canada's export market for canola seed, oil, and meal is faced with further competition from EC exports, with a potential shift in Japan to soybean imports. India and China are potential new markets for Canadian canola.

The Soviet Union, China, and Japan will continue to be the major grain markets. These countries are unable to produce enough wheat, coarse grains, and oilseeds for their domestic market. Canada has established itself in those markets and will have to continue to supply them in the future. If Canada were to lose any of those three markets, the income to Prairie producers would be seriously eroded.

The future of the Prairie grain economy is both optimistic and uncertain. While there will be growth in demand for food products, the price of such products will depend upon government policy.

Conclusion

The price of wheat and coarse grains bottomed out in 1987 but started to increase in 1988. The reasons for this increase have been adequately described in this paper. Oilseed prices appear to have increased in 1987 and 1988, with the demand for oilseeds continuing to increase faster than the supply.

Exactly when Prairie farmers will experience an increase in grain prices will depend upon government policy. If we expect government transfer payments to grain producers to decline as market prices increase, it will be some years before farmers receive a price increase. How subsidy payments to grain producers will be replaced in relation to increases in the market price has yet to be determined.

The future of the Prairie grain economy, to the extent that it is determined by grain prices, will be unstable. There is no reason to expect the fluctuations in grain prices to disappear; however, we do currently expect prices to increase and our fortunes to adjust accordingly.

Appendixes

A Analysing the Relationship between Wheat Stocks and Wheat Prices

Unlike most foodstuffs, grains are a storable commodity; thus annual world consumption does not have to match annual world production. Stocks, as a proportion of total grain use, rather than production provide a measure of the abundance of grains. An examination of the data for the last 25 years clearly indicates that a wheat stock/price relationship exists.

Based on the observed stock/price relationship, the following model was developed to test the hypothesis that the U.S. farm price gets very close to the loan rate when the stock/use ratio becomes equal to, or greater than, 20 per cent and that prices start rising once the stock/use ratio goes below 20 per cent:

$$P - L = b_0 + b_1 SR + b_2(SR - 20 \text{ per cent}),$$

where P = U.S. farm price of wheat;
L = the loan rate;
SR = year-end wheat stocks as a percentage of annual wheat consumption; and
b = the estimated coefficients.

With D = 1 for $SR > 20$ per cent or
0 for $SR < 20$ per cent,

the estimated equation is:

$$\begin{aligned} P - L &= 408 - 19.8{*}SR + 18.7(SR - 20 \text{ per cent})D \\ &\qquad\quad (-3.31) \qquad\quad (2.84) \\ R^2 &= 0.50 \end{aligned}$$

The numbers in parentheses are t-values.

This equation can be broken down into two equations – where $SR > 20$ per cent and where $SR < 20$ per cent.

For a stock/use ratio of less than 20 per cent,

$$P - L = 408 - 19.8{*}SR; \tag{1}$$

and for a stock/use ratio of greater than 20 per cent,

$$P - L = 31 - 1{*}SR. \tag{2}$$

The first equation shows a large intercept term, which implies a huge discrepancy between farm prices and the loan rate as year-end wheat stocks approach zero, and a negative slope, which shows that as wheat stocks as a percentage of consumption rise, the difference between the farm price and the loan rate will be smaller. The second equation shows that after a stock/use ratio of 20 per cent is reached, the intercept term and the slope of the curve become zero – and neither of these coefficients are significantly different from zero. Therefore, once the wheat stock/use ratio reaches 20 per cent, the price of wheat goes down to the level of the loan rate.

A similar relationship exists between coarse-grain stocks and the U.S. corn price. In the case of coarse grains, the critical stock/use ratio is 16 per cent. As the coarse-grains stock/use ratio approaches 16 per cent, corn prices tend to be very close to the loan rate. At rates lower than 16 per cent, the corn price significantly exceeds the loan rate.

B Forecasting World Wheat and Coarse-Grain Production

Wheat

In order to project the wheat production of the world to 1990 and 1995, the supply response is estimated for three major wheat-growing regions: Canada, the European Community, and the United States. These regions were selected because of their importance in export markets and because of the availability of cost-of-production data.

The supply response is determined by the resources employed, production technology, and government policies that may insulate producers from price changes. In order to incorporate those three factors, the analysis is divided into three parts: the estimation of the cost of production; the examination of the effects of government policies on the quantity of wheat produced in the major exporting countries; and the forecasting of production for the major wheat-growing countries to 1990 and 1995.

First, the cost of production and wheat yields were obtained for different cultural practices in each of the above regions. It was then assumed that producers in each of those areas would select the cultural practice that would maximize their profits. That behaviour was simulated using a linear programming model for Canada, the United States, and the European Community.

In the model it was assumed that producers, on average, would select the most profitable cultural practice for wheat in each crop district in western Canada, which, as a region, produces over 97 per cent of the wheat grown in this country. In western Canada, the practice of summer fallow is common. It was assumed that a producer could reduce the cropped area and increase the summer-fallow area with no additional machinery costs. If an increase in the cropped area was considered, however, the additional cost of machinery, depreciation, and investment was included as an explicit cost. Other than that, all land, machinery, and labour were assumed to be fixed within the sector, and farmers maximized returns over variable costs.

The supply response of Canada indicates a wide range of production costs between cultural practices and crop districts. Some production (0.5 million tonnes) has a variable cost of less than US$33/tonne, while at higher levels of output (26.5 million tonnes) it would cost US$195 to produce an additional tonne. The production response to a change in price varies considerably. At $90/tonne, a decline of 10 per cent in the price will decrease production by 1.4 per cent, while at $50/tonne, a similar price decline will bring about a reduction of 28 per cent in production.

In order to estimate the U.S. supply response, the 1983 cost-of-production estimates from the Economic Research Services of the U.S. Department of Agriculture, which describe the cost of wheat production by wheat type, by state, and by cultural practice, were used. Production costs varied considerably across the United States. The highest costs were borne by producers of irrigated wheat in the southwestern United States; the lowest costs, by producers of hard red winter wheat on the Great Plains and of white wheat in the Palouse area of Washington state. The practice of summer fallow is prevalent in many areas of the United States, except in the East where soft red winter wheat is grown. The supply response to alternative farm prices is very similar to that of Canada, with an inelastic portion above $70/tonne and an elastic portion below $70/tonne.

Upon first observation of the Intensive Cereal Management system and of the very high rates of variable inputs per hectare used in the European Community, one would conclude that the system is very expensive and could only be maintained in an environment of protected prices. Given the very high yield, however, this system of production has variable costs per unit of output that compare favourably with those in Canada and the United States.

The range of production costs in the European Community is quite wide because of the variety of climatic conditions, soil fertility, and agronomic practices. In order to estimate the supply response for the European Community, the costs of production were estimated for the United Kingdom, France, and West Germany. In 1984, those three countries produced 70 per cent of the EC total. The wheat-production cost data for this study were compiled from those provided by the Farm Accounting Data Network (FADN) of the European Commission and from work done by B. F. Stanton (1986) and M. C. Murphy (1985). The EC wheat-supply curve is made up of two distinct sections. Above US$70/tonne, the curve is very inelastic, and production is only slightly affected by price; below US$70/tonne, the curve is very elastic. The current production levels are the most economical, with a wide price range of US$75/tonne to US$150/tonne. If prices fall below US$75/tonne, the lower-yield production activities generally remain uneconomical; instead of a transfer into those production activities, land would tend to drop out of production. The effect of additional investments, which become fixed in the sector, is lower output levels – once economical but now uneconomical regardless of price. On the other hand, higher-yielding technologies do not become feasible until prices exceed $150/tonne. Over time, this investment has shifted the very inelastic portion of the supply curve to the right. The inelastic portion of the supply curve indicates that European production would decrease very little even if there were a substantial price decrease. This is similar to the conclusion reached by Murphy.[1]

In the absence of major agricultural policies, the estimated wheat-supply curves show a remarkable similarity. Within the range of prices that have been experienced in recent history, the supply response of producers, in all three regions, is very inelastic.

The next stage of analysis involves incorporating the effects of government policies on supply response. In Canada, the major programs affecting grain production include the *Western Grain Stabilization Act*, the *Western Grains Transportation Act*, and the *Special Grains Assistance Act*. The effect of the *Western Grain Stabilization Act* is to guarantee, in statute, a transportation subsidy of C$640 million (US$480 million) to grain producers, and it includes some provisions to increase the subsidy if freight costs increase. The removal of that subsidy, in the short run, would decrease the average Canadian farm price of wheat by US$16/tonne, resulting in a decrease in supply. The effect of the Crow Rate is a permanent shift in price of US$16/tonne and an increase in production of 8 per cent, or 1.6 million tonnes.

The *Special Grains Assistance Act* translates into a subsidy of US$11/tonne. It was announced after the 1986 harvest and was therefore expected to have a large impact on 1987 seeding intentions, as producers anticipated further payments. The net effect of the WGSA and deficiency payments, assuming that producers are compensated for half of the price drop below US$110/tonne, in the 1986/87 crop year – with a price level of US$81/tonne – was to increase production by 4 per cent, or by 960,000 tonnes. The combined effect of those programs at US$81/tonne is to increase Canadian wheat production by 12 per cent, or by 2.5 million tonnes.

In the United States, the impact of government programs on production is very complex. The policies that have a significant effect on production include the target price, the loan rate, production subsidies, acreage reduction, paid diversion, and the soil conservation reserve.

The supply curve is representative of production levels in response to alternative farm prices. To describe the supply at alternative average export prices, one must consider the gap between the farm price and the export price in a subsidized-versus-nonsubsidized environment. Historically, the U.S. loan rate has supported both the U.S. price and the world price, and has therefore changed the relative trade flows very little. Current estimates suggest that the Canadian farm-gate prices will average US$12/tonne less than comparable U.S. prices. In addition to this subsidy, the other direct subsidy of US$420 million involves the operation of the inland waterway system. That subsidy is relatively small.

The largest form of income support for wheat farmers is derived from deficiency payments. If the market price in the United States is below the target price, then eligible producers receive a payment from the government to make up the difference. Target prices have generally been maintained above the market price, except during the 1972-76 and 1980-81 periods. In the 1986/87 crop year, deficiency payments were expected to be US$70/tonne, with U.S. farm prices hovering around US$88/tonne. A subsidy of that magnitude would normally lead to a large increase in production; in the United States, however, that may not be the case. First of all, in order to be eligible for the program, wheat farmers must participate in acreage-reduction programs. In 1985 and 1986, such reductions reduced U.S. seeded acres by 10 per cent and 20 per cent, respectively. The current production levels, however, will affect future government payments. It becomes an empirical question, therefore, whether the combination of high target prices, deficiency payments, and acreage-reduction programs increase or reduce wheat production.

The cost-of-production supply model indicates that at an average farm price of US$88/tonne (US$2.40/bu), wheat production should equal 76 million tonnes; the observed production, however, was only 61 million tonnes. The reason for the larger estimate of production under a scheme of no deficiency payments and no acreage-reduction programs is straightforward. The larger acreage of summer fallow in the United States in 1985 and 1986 cannot be explained on the basis of profit maximization at US$2.40 for wheat, because at such a price level, intensive rotation is more profitable.

The long-term impact of the U.S. farm policy is difficult to estimate. There is little doubt that the deficiency payments – and the stability they provide – have increased capital accumulation in the sector, bringing new land and more input-intensive technologies into existence; these are now effectively fixed within the sector. The soil conservation reserve, designed to take 45 million acres of land out of annual crop production over the next five years, will offset some of the new land development. In 1987, 20 million acres of farmland were affected by that program.

In conclusion, if the United States removed deficiency payments and the acreage-reduction program, wheat production would increase by about 20 per cent; on the other hand, if it discontinued its Bonus Incentive Commodity Export Program, the difference between the U.S. price and world prices would decline. At the 1986/87 export price of US$81/tonne, total U.S. wheat production would increase by 18 per cent if BICEP, deficiency payments, and the acreage-reduction plans were all abandoned.

Government policy has had a tremendous impact on European agriculture. The CAP has intervened heavily in the agricultural sector, keeping prices well above the world level. A study of CAP by the Bureau of Agricultural Economics found that between 1967 and 1981, grain prices were, on average, 35 per cent above world prices. In the 1986/87 crop year, the average price for common wheat was US$178/tonne (US$4.86/bu) – an Agra Europe estimate. The effect of the high level of support is difficult to measure. The price support has encouraged massive investment in the agricultural sector, which, when combined with the change in technology, has caused wheat production to increase. The extent to which this supply response has been induced by the high supports is impossible to determine. It is possible, however, to address the question of how much the European Community would produce if the CAP were removed and if European producers were faced with the 1986/87 export price of US$81/tonne.

If the European Community were to move to a "free market" price, the production effect would be small. On the basis of the cost-of-production supply model, production would drop from 74 million tonnes to 68 million tonnes, or be 6 per cent in the short run. The long-run effect would be larger, as lower prices would halt any new investment in the sector, thus maintaining production at the 68-million-tonne level. If the European Community were to continue providing the high level of support and if production should continue to grow at trend, the latter would reach 82 million tonnes by 1995. If the European Community removed all price supports by 1995, its production would be 14 million tonnes less than if the present price supports were continued until that date.

In Australia, government policy has historically not played a large role in the production of wheat. As a result, the farms tend to be large, somewhat less debt-burdened, and more diversified than U.S and Canadian farms. Most indications are that the Australian government will continue to be somewhat reluctant to subsidize agriculture. At the present time, the government has two policies to stabilize income. It has a two-price wheat system to discriminate against the domestic market. The domestic price is set at the export asking price, plus verifiable additional costs. For the first six months of 1987, the domestic price of Australian standard white wheat for human consumption was set at just over Aus$190/tonne, or about US$21/tonne over the asking price. Given the small proportion of wheat that is used for human consumption, the subsidy of US$21/tonne only increased the average pooled price by US$1.47/tonne, or US$0.04/bu.

The other policy, which at times supports the price in Australia, is the mechanism that determines the Guaranteed Minimum Price (GMP) or provides an initial payment from the Australian Wheat Board (AWB). The final GMP is set at 95 per cent of the average expected price for the crop year, plus the lowest of the two average prices for the previous three crop years. Since the inception of that policy in 1979, there has never been a deficit in the AWB pool accounts; however, in the 1987/88 crop year, there is expected to be a deficit of US$10/tonne or US$20/tonne in the pool account. For the purpose of analysing the effect of these policies on the production of wheat, it is assumed that the Australian government will increase the price to Australian producers by one-third of the difference between the current world export price and US$110/tonne. If Australia's supply response function is similar to Canada's, then the effect of those policies is relatively small. At the 1986/87 price of US$81/tonne, the net increase in production is only 0.7 million tonnes, or 5 per cent of the current production levels.

The agricultural industry dominates the Argentine economy. As such, the government cannot afford to subsidize the agricultural sector. Rather, the government has taxed agricultural exports via an export tax, in order to generate revenues from that sector and to stimulate the processing of primary agricultural products. In January 1987, the Argentine government announced a reduction in the export tax, from 15 per cent of its value to 5 per cent, and replaced it with a land tax. That change will help to offset some of the effects of the decline in export prices by increasing the price to producers. In the 1986/87 crop year, there were no significant subsidies affecting wheat production in Argentina, and if the remaining 5-per-cent export tax were to be removed, that would approximate a free-market response, which would increase the farm price by a similar amount. If the supply response is similar to that of Canada, the decrease in production caused by the drop in the world price with a 15-per-cent export tax would have been 3.2 million tonnes, or 32 per cent. With the reduction of the export tax to 5 per cent offsetting some of the price effect, however, production will only decrease by 0.9 million tonnes, or by 9 per cent. If the 5-per-cent tax were removed, production would only decrease by 0.6 million tonnes. The net effect of the current 5-per-cent export tax, at current prices, is to reduce production by 0.3 million tonnes.

Coarse Grains

In order to project the world production of coarse grains to 1990 and 1995, past trends in the production of countries and regions that accounted for more than 80 per cent of world production were studied. In Canada, the United States, and the European Community, government programs apply to wheat and coarse grains in the same way. Those policies were discussed in Chapter 4, as they apply to the production of coarse grains.

Three scenarios, based on three different assumptions of future growth rates in production, were developed. In the "most likely" scenario, a significant increase in Chinese yields of coarse grains was assumed. The assumption made for other countries and regions were reported in Chapter 4.

C Forecasting World Consumption of Wheat and Coarse Grains

Methodology

Consumption forecasts for wheat and coarse grains are made on a per-capita basis. Total consumption projections are then computed by using the projected populations of the countries in the sample.

Per-capita consumption of wheat and coarse grains is forecasted by using the following formula:

$$C^{0+t} = C^0(1 + r_y \cdot n_y)^t,$$

where C^0 = per-capita consumption in base period;
$0 + t$ = future year for which the projection is made;
r_y = rate of growth in per-capita income; and
n_y = income elasticity of demand for wheat (coarse grains).

Income Elasticity of Demand

The income elasticity of demand for wheat is estimated for country groups by pooling time-series and cross-sectional data.

For countries where wheat consumption is expected to remain far below the saturation level over the projection period – e.g., Guatemala, Zimbabwe, Salvador, and Indonesia – the following functional form for per-capita consumption was adopted:

$$\ln C = a + b \ln y,$$

where y = per-capita income; and
$n_y = b$.

For countries where wheat is not the staple food – e.g., Japan, South Africa, and Ecuador – the following functional formula was adopted:

$C = a + b \ln y$, which yields an income elasticity of demand that is inversely related to the quantity consumed; and
$n_y = b/C$.

For the developed industrial countries of Eastern Europe and the Soviet Union, where per-capita wheat consumption has already peaked, we adopted the following functional formula, which provides for a saturation level:

$\ln C = a + b \ln y$, which yields the following income elasticity of demand; and
$n_y = b/y$. This implies a lower elasticity for the higher levels of per-capita income.

For the group of countries where wheat is a basic food staple, per-capita wheat consumption is expected to increase as income rises, to reach a maximum, and then to start declining at high levels of income. Some of the countries in that group are Egypt, Pakistan, India, Syria, Morocco, and Turkey. This relationship between per-capita consumption and per-capita income is captured in the following functional formula:

$\ln C = a + b/y + d \ln y$; and the income elasticity of demand derived from this is
$n = b/y + d$.

The effect of the price on per-capita wheat consumption is totally ignored for two reasons. First, the domestic prices in almost all of those countries are different from world market prices; thus the demand for wheat is inelastic with respect to world prices, and it is very difficult to collect consistent price series for each country in the sample. Second, over the last two decades, the population growth rate accounted for two-thirds of the increase in the world's grain consumption, and another important factor that affected the change in grain consumption during that period was the change in per-capita income (*The Economist*, "Wheat to 1991," pp. 14-16).

The demand for coarse grains is a derived demand; hence, the income elasticity of the demand for meat was estimated and applied to the consumption forecasts for coarse grains. For this estimation, time-series and cross-sectional data were pooled, and the following functional formula was adopted:

$\ln C = a + b/y$, which provides for a saturation level and yields the following income elasticity
$n_y = -b/y$.

This income elasticity was also applied to wheat used for animal feed.

The income elasticities of the demand for wheat and coarse grains [meat] in selected countries are reported in Table C-1, and they were applied to the forecasts in each of the three scenarios developed.

Growth Rates

Three different scenarios were developed to forecast the consumption of wheat and coarse grains to 1990 and 1995, and they were based on the different rates of growth in per-capita GDP for each country group.

For the base-case scenario, the growth rates in GDP per capita in the period 1980-85 were assumed to continue. In the high- and low-case scenarios, the high- and low-growth rates projected by the World Bank were used, as shown in Table C-2. Those rates were based on the assumptions which are summarized in the following paragraphs.[1]

Table C-1

Income Elasticity of Demand for Wheat and Coarse Grains, Selected Countries

	Wheat	Coarse grains
	(Per cent)	
Argentina	0.015	0.65
Australia	–0.27	0.05
Canada	–0.24	0.04
China	0.75	1.69
EEC-10	–0.37	0.07
Eastern Europe		
Bulgaria	–0.45	0.11
Czechoslovakia	–0.34	0.08
Germany D.R.	–0.24	0.06
Hungary	–0.26	0.26
Poland	–0.51	0.12
Romania	–0.73	0.18
Yugoslavia	0.08	0.30
India	1.06	2.13
Pakistan	0.62	1.50
Portugal	–0.22	0.31
Spain	0.16	0.13
United States	–0.20	0.04
Soviet Union	–0.42	0.10

SOURCE Estimates by the authors, based on U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Circular Series FG-2-87, January 1987.

In both the high- and low-case scenarios, the stabilization and structural-adjustment policies in developing countries are expected to improve moderately. Even with those improvements, however, the low-case scenario will pose serious problems for many countries.

Both cases reflect the positive effects of lower oil prices and real interest rates on inflation and growth, but low oil prices are expected to hinder growth in oil-exporting countries.

The high-case scenario is based on the assumption that the fraction of world credit absorbed by government deficits in industrialized countries will be steadily reduced. This will create higher rates of growth of investment in productive assets and an increase in capital stock. These developments are expected to lead to higher output and employment, as well as reduced barriers to trade, which in turn will result in an accelerated growth of 4.3 per cent per year in the industrialized countries. If the United States reduces its government deficit, nominal and real interest rates are expected to decline to an average of 5.6 per cent and 2.6 per cent, respectively.

Table C-2

Growth of GDP per Capita (Average Annual Percentage Change), Selected Country Groups

		1985-95	
	1980-85	High	Low
		(Per cent)	
Industrial countries	1.7	3.8	2.0
Developing countries	1.3	3.9	2.0
Low-income countries	5.2	4.4	2.5
Africa	2.0	0.8	0.0
Asia	5.9	4.8	2.8
Middle-income oil exporters	–1.1	2.3	0.9
Middle-income oil importers	–0.1	4.1	1.9
Major exporters of manufactures	0.2	4.6	2.2
Other oil-importing countries	–0.8	3.1	1.4

SOURCE The World Bank, *World Development Report 1986* (New York: Oxford University Press, 1986), p. 45

In the high-case scenario, developing countries will find it easier to service their debts, through more-rapid export growth and lower interest rates. But even in this scenario, some sub-Saharan African countries and some heavily indebted oil exporters will find it very difficult to adjust and to grow.

The low-case scenario illustrates what would happen if industrialized countries were to abandon the tentative policy reforms adopted in the early 1980s. Abandonment of those policies imply unchecked budget deficits – particularly in the United States – and increasing real interest rates, which would reduce commercial bank lending to developing countries and increase the trade deficit in developed countries. Growing trade deficits in developed countries will give rise to protectionist policies. This, in turn, will reduce the demand for exports from developing countries and lower the commodity prices.

The consequences of the low-case scenario for developed countries are lower growth rates (similar to, or less than, those of the uncertain 1970s), as well as higher real interest rates (4.5 per cent) and rising inflation rates (5 to 7 per cent).

For developing countries as a group, the low case means a growth rate of around 2.0 per cent. Middle-income exporters of manufactures could sustain growth at comparatively low levels. For others, the low case means another decade of negative or no growth. Middle-income oil exporters would likely not achieve any increase in real income. Low-income African countries would suffer another decade of stagnation. For heavily indebted middle-income countries, the consequences of the low-case scenario would be rather severe. Those countries would face the task of deciding how much of their resources should be channeled to the servicing of existing debt and how much to current consumption and investment.

Notes

CHAPTER 1

1 P. J. Molder, "The comparative advantage of grain production in the northern plains," unpublished M.Sc. thesis, University of Saskatchewan, Saskatoon, Saskatchewan, 1986.

2 T. Josling, *An International Grain Reserve Policy* (New York: British-North American Committee, 1973); and A. Schmitz, "Commodity price stabilization, the theory and its applications," World Bank Staff Working Paper No. 668, Washington, D.C., 1984.

3 W. H. Furtan, R. Gray, A. Schmitz, and A. Ulrich, *International Wheat Markets: The Options Available to Saskatchewan*, Report submitted to the Government of Canada and the Government of Saskatchewan (Saskatoon: University of Saskatchewan, 1987).

CHAPTER 2

1 G. Storey, H. G. Coffin, and K. A. Rosaasen, *An Analysis of the Canadian Feed Grain Market Information System*, a study prepared for the Government of Canada (Saskatoon: University of Saskatchewan, January 1984).

2 Molder, "Grain production in the northern plains."

3 H. M. Austenson, "Principles of agronomy with particular reference to Saskatchewan conditions," Crop Science Department, University of Saskatchewan, Saskatoon, 1979, mimeo.

4 K. Karadininis and G. Storey, *Western Canadian Grain Handling and Transportation Systems: The Impacts of Variable Freight Rates*, Department of Agricultural Economics, University of Saskatchewan, Saskatoon, Saskatchewan, July 1986.

5 B. T. Oleson and H. G. Brooks, "Canadian Wheat Board proposal: Basis for change for initial payment freight deductions," *Canadian Journal of Agricultural Economics*, No. 34 (May 1987).

6 Karadininis and Storey, *The Impacts of Variable Freight Rates*.

7 M. Fulton, K. Rosaasen, and A. Schmitz, "Canadian agricultural policy and Prairie agriculture," a working paper for the Economic Council of Canada, June 1988.

CHAPTER 3

1 U.S. Department of Agriculture (USDA), Foreign Agricultural Services (FAS), *World Grain Situation and Outlook*, Circular Series FG-9-87 (Washington, D.C.: August 1987).

2 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

3 USDA, FAS, *World Grain Situation*, various issues.

4 A. F. McCalla and T. T. Josling, *Agricultural Policies and World Markets* (New York: Macmillan, 1985), p. 78.

5 Canadian Wheat Board (CWB), *Annual Report, 1985/86*, pp. 19-20.

6 McCalla and Josling, *Agricultural Policies*, p. 88.

7 W. H. Furtan *et al.*, *International Wheat Markets: Options Available to Saskatchewan*, a report prepared for the Government of Canada, 1987.

8 CWB, *Annual Report, 1985/86*.

9 CWB, *Annual Report, 1985/86*.

10 USDA, Economic Research Service, *Wheat: Background for 1985 Farm Legislation*, Agricultural Information Bulletin No. 467 (Washington, D.C.: September 1984), p. 6.

11 USDA, ERS, *Wheat*, Agricultural Information Bulletin No. 467, p. 6.

12 J. Pearce, *The Common Agricultural Policy: Prospects for Change* (London: Routledge Publishing, 1981).

13 R. Woodhams, "Wheat to 1991: Adapting to oversupply," *The Economist Intelligence Unit*, Special Report 1070 (London: The Economist Publications Ltd., 1986), p. 87.

14 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

15 International Wheat Council, *World Wheat Statistics*, various issues.

16 Woodhams, "Wheat to 1991," p. 87.

17 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

18 USDA, FAS, *World Grain Situation*, Circular Series FG-2-87, January 1987.

19 Woodhams, "Wheat to 1991," p. 87.

20 USDA, FAS, *World Grain Situation*, Circular Series FG-2-87.

21 McCalla and Josling, *Agricultural Policies*, p. 78.

22 USDA, FAS, *World Grain Situation*, Circular Series FG-2-87.

23 Woodhams, "Wheat to 1991," p. 87.

24 World Bank, *World Development Report* (Oxford: University Press, New York, 1987).

25 USDA, FAS, *World Grain Situation*, Circular Series FG-2-87.

26 USDA, *World Agricultural Supply and Demand Estimates*, WASDE-209, September 10, 1987.

27 Argentine farmers, however, have traditionally not paid property taxes. Only since 1986 has Argentina begun to switch from export taxes to property taxes in the hope that land taxes will encourage more-intensive crop and pasture production.

CHAPTER 4

1 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

2 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

3 USDA, *Agricultural Supply and Demand*, WASDE-209, 1987.

4 USDA, *Agricultural Supply and Demand*.

5 USDA, *Agricultural Supply and Demand*.

6 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

7 USDA, *Agricultural Supply and Demand*.

8 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

9 EC-12 includes Belgium-Luxembourg, Denmark, France, West Germany, Greece, Ireland, Italy, Netherlands, United Kingdom, Spain, and Portugal.

10 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

11 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87, p. 19.

12 International Wheat Council, *Review of the World Wheat Situation, 1985-86* (London: IWC, 1986), p. 37.

13 Woodhams, "Wheat to 1991."

14 Woodhams, "Wheat to 1991."

15 Food and Agriculture Organization of the United Nations (FAO), *Trade Yearbook*, various issues.

16 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

17 USDA, FAS, *World Grain Situation*, Circular Series FG-9-87.

CHAPTER 5

1 Price Waterhouse, "Task force on the future of the canola industry," an unpublished discussion paper for the Canola Council of Canada, January 13, 1986.

2 Price Waterhouse, "Task force on the future of the canola industry."

3 S. Mielke, *Oil World: Statistics Update* (Hamburg: ISTA Mielke GmbH, West Germany, 1983).

4 Grain Marketing Office, *Fats and Oils in Canada, Annual Review* (Ottawa: Department of External Affairs, 1986).

5 G. G. Storey, "World agricultural and trade policies: Implications for western Canadian oilseed industry," *Future Prospects for World Agricultural Policies and Trade: Implications for Western Canada Proceedings* (Saskatoon: University of Saskatchewan, 1984).

6 The gross crushing margin was crudely estimated using the Saskatchewan farm price of canola/rapeseed and the U.S. price of crude soybean oil and 44 per cent soybean meal at Decatur, Illinois.

7 J. Blahut, "An econometric model of the international linseed oil and linseed meal markets," unpublished M.Sc. thesis, University of Saskatchewan, April 1986.

8 See footnote 4.

9 EC-10 includes Belgium-Luxembourg, Denmark, France, West Germany, Greece, Ireland, Italy, Netherlands, and the United Kingdom.

10 If the 12 major meals are taken into account, the self-sufficiency level falls to 47 per cent.

11 Estimates of net returns are not available.

12 M. D. Faminou and J. S. Hillman, *Brazil's Response to the U.S. Soybean Embargo*, Department of Agriculture Economics (Tucson, Ariz.: University of Arizona, 1986).

13 USDA, Economic Research Service, *Embargoes, Surplus Disposals, and U.S. Agriculture* (Washington, D.C.: U.S. Department of Agriculture, Staff Report No. AGES860910, November 1986).

14 Faminou and Hillman, *Soybean Embargo*, p. 35.

15 Faminou and Hillman, *Soybean Embargo*, p. 35.

16 Winrock International, *Agricultural Development Indicators* (Morrilton, Kansas: Winrock International Institute for Agricultural Development, 1987).

17 Winrock International, *Agricultural Development Indicators.*

CHAPTER 6

1 R. E. Just and G. C. Rausser showed that futures prices are better forecasters in "Commodity price forecasting with large-scale econometric models and the futures market," *AJAE*, May 1981.

2 C. Carter and Fu-Ning Zhong, *China's Grain Trade: An Economic Analysis* (London: Westview Press, 1988).

3 W. H. Meyers, "Long-run income growth and world grain demand: An econometric analysis," unpublished Ph.D. dissertation, University of Minnesota, 1977.

APPENDIX B

1 M. C. Murphy, *Report on Farming in the Eastern Counties of England 1983/84* (Cambridge: University of Cambridge, Agricultural Economics Unit, Department of Land Economy, January 1985).

APPENDIX C

1 The World Bank, *World Development Report 1986* (New York: Oxford University Press, 1986), pp. 40-50.

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